TANGANYIKA

DEPARTMENT OF AGRICULTURE

ANNUAL REPORT

1953

PART II

Experiments, Investigations and Reports of Specialists and Fishery Officers

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INTRODUCTION

A wide range of scientific and field trial work is being covered. This report contains accounts of the investigations carried out by the Department of Agriculture and of those bodies which are closely associated in research programmes. I refer to the Empire Cotton Growing Corporation which maintains a staff of scientific workers on two of our experiment stations, the Tanganyika Sisal Growers' Association which meets the entire cost of a very comprehensive series of experiments and researches and whose staff includes officers seconded from the department. The Tanganyika Coffee Board and the Bukoba Native Coffee Board contribute largely to the cost of coffee experiment stations and the Lint and Seed Marketing Board with its two provincial cotton committees are substantial supporters of cotton improvement and inter-related agronomic studies. Mention is also made of collaboration with the East African Agricultural and Forestry Research Organization, and the recent entry of the Colonial Insecticide Research Unit into the sphere of experimentation on the suppression of crop pests.

Specialists who work in Government departments and for such bodies as are mentioned above have to eschew to a large extent the pursuit of academic researches in order to devote themselves primarily to seeking answers to questions of an economic significance. The following pages record the progress made on these lines. Trials with fertilizers are beginning to show on what crops and under what conditions they can profitably be used—as on cotton and pyrethrum. The study of the effects of calcium and of soil acidity on the growth of sisal promises to lead to results of practical value on sisal estates, particularly on those which have been cropped for some time. The residual effects of phosphates and of organic manures as recorded from Ukiriguru may have great significance for peasant agriculture. The entomological sections of this report indicate that real advances are being made in the use of modern insecticides against such pests as the coffee borer and bollworms of cotton. Progress has been made in the selection of useful types of sorghum for short-term cultivation. The new agricultural station for coconuts and coastal crops is becoming well established, and the purchase of a farm by the tobacco growers of the Southern Highlands may be noted here as a venture which will necessitate the writing of a larger section on tobacco breeding and experimentation for future annual reports.

C. E. J. BIGGS,
Director of Agriculture

PROGRESS REPORT OF THE UKIRIGURU AGRICULTURAL STATION FOR THE SEASON 1952-53

Planting:
At Ukiriguru, 19th November—19th December, 1952;
At Lubaga, 24th November, 1952—23rd January, 1953;
By Cultivators, November, 1952—February, 1953.
Picking:
April until August.
Legal uprooting date:
15th September, 1953.
(Geita District—1st September, 1953.)
Rainfall for the period 1st October to 30th June:
Ukiriguru: 19.25 inches.
Lubaga: 20.20 inches.

Meteorology

In contrast to the previous season the rainfall for 1952–53 was the poorest since these records were started. The early planting rains were very poor. Following some good showers in early January the seven weeks' period until the end of February was dry. The rains from the beginning of March into May were good. But taken all over it was a very difficult droughty season.

Staff

Mr. J. E. Peat was on vacation leave from the end of June until early December.

Mr. J. E. Peat attended in January, 1953 a meeting in Nairobi of the East African Advisory Council on Agriculture, Animal Husbandry and Forestry, in place of Dr. J. D. Hutchinson who was on leave; and in February, 1953 a conference in Nairobi on Crop Responses to Fertilizers and Manures, at which he presented a paper "Fertilizer Responses—Ukiriguru". On his way back from vacation leave in early December, 1953 he attended the Namulonge Advisory Board Meeting.

Mr. D. Lawes, while on an E.C.G.C. studentship, worked for six weeks at Ukiriguru.

Mr. H. Doggett, botanist of the Department of Agriculture, is responsible for the all-important food crop work at Ukiriguru, mainly sorghum breeding. The association with him has always been a most pleasant one.

During the season Mr. R. A. Brown, Field Officer (Agriculture), and his assistants, Mr. A. D. P. Angelini, Junior Field Officer, and Mr. I. S. Mkwawa, Assistant Agricultural Officer, have most ably coped with the greater part of the routine station running.

Mr. James Bushiri, Senior Clerk, after twenty-five years in Government service, of which twelve years have been spent in charge of the Ukiriguru Station office, is about to retire. On Mr. May's visit he was presented with a clock in appreciation of his services at Ukiriguru.

GENERAL INTRODUCTION

The season 1952–53 was probably the worst experienced in the Lake Province in the twenty-two years that records have been kept at Ukiriguru; and from reports, one of the worst for half a century. In the circumstances the cotton production of 38,221 bales is considered satisfactory. The acreage planted was reported as approximately half that of the previous season. Much of the cotton was late planted.

At Ukiriguru yields in the variety trials under conditions of fairly good fertility were amongst the highest we have recorded. In the Exhaustion Plot, continuously cropped under cotton for twelve years, the yield, the highest in the twelve years, was 922 lb. seed cotton/acre (compared with 326 lb./acre the previous season and a mean for the twelve years of 505 lb./acre). In the Lake Province Cotton Committee district fertilizer tests—to be referred to later—the mean control yield was 794 lb. seed cotton/acre. At Lubaga cotton yields were poor to only fair.

In general there was little American bollworm damage; the patchy early planting rains had made difficult any early establishment of maize. On Ukiriguru very considerable American bollworm populations were attracted to bulk maize in mid-May while the cotton escaped attack. Bacterial blight loss was generally unimportant. It was the lightest attack in the last nine seasons though some district reports of blight damage were received. (In seven of these seasons bacterial blight caused either severe or very severe loss in the cotton crop.)

1953–54 Cotton Planting

The 1953-54 season has started well. Rains to the end of January though in some areas on the light side have been fairly well distributed. It is reported that the cotton acreage may be a record. Stands are reported as good. Nearly half the seed issue was dusted with perenox. There has been a drive for rotation.

Approximately 150 tons of Uk. 51 have been distributed to growers in the Buchosa zone and approximately 2,700 lb. of Uk. 53 have been distributed to 169 growers in Kome Island. The Shinyanga District has been planted with Uk. 46; the rest of the Province is under Uk. 48.

Bacterial blight loss may be anticipated especially in the areas using undusted seed and where rotation has not been practised; and the chances of American bollworm damage have to be faced. There have been considerable plantings of early maize to provide much needed early food. On the first of these plantings, tasseling at the time of writing (early February), there are American bollworm larval populations.

SUMMARY OF THE MAIN RESULTS AND PROGRESS

Compared with continuous cultivation an increase in cotton yields following "tumbledown" and planted fallows is again recorded in the first and second cropping years. The "tumbledown" fallows have given increases equal to or greater than the planted fallows; they were similar to the increases obtained from the compost or phosphate dressings applied to treatments continuously cropped.

In the now nearly classical Trial (8) residual responses to the 7 tons/acre dressing of F.Y.M. applied in 1944 were still over 200 lb. seed cotton/acre; the residual responses to the lower dressing of F.Y.M. and to the compost dressings were not significant. There was still a very large residual increase, over 400 lb. seed cotton/acre, from the heavy cotton seed ash dressing.

The manurial and fertilizer responses in general were similar to other years with somewhat smaller responses to phosphate. Top-dressing with sulphate of ammonia gave good responses in some trials with no significant response in others. The Lake Province Cotton Committee district fertilizer tests carried out on a considerable number of African shambas in the Mwanza area showed worth-while responses to the application of phosphate and to top-dressing with sulphate of ammonia.

At Ukiriguru the cotton responses to tying ridges were good. At Lubaga in two experiments both cotton and sorghum showed large increases when grown on tied ridges compared to flat cultivation.

A Uk. 53 was constituted and issued for first multiplication.

The important crossing programme with Albar 51 continues, breeding for resistance to bacterial blight.

There was a marked reduction in early bacterial blight infection following seed dusting; but there were no yield differences. It was a year of very mild bacterial blight attack.

At Ukiriguru in early May considerable American bollworm egg-laying occurred on bulk maize. Cotton escaped attack; the maize having acted as a trap.

GENERAL ACCOUNT OF THE WORK FOR THE SEASON

Husbandry

Land Resting.—Of the four original resting crop trials, Trials (1) and (2) were carrying their ninth indicator crop, and Trials (3) and (4) their seventh indicator crop. They are now being discontinued. There were still this past season suggestions of residual responses to the various resting treatments but none were significant. In Trial (1) however, the manure, 5 tons/acre F.Y.M. applied at the digging in of the millet, control and the elephant grass rest in 1944 still showed a significant increase, 150 lb. seed cotton per acre over the unmanured control.

TABLE 1.—RESTING CROP TRIAL

Ukiriguru—Hill Sand—Trial (5)

Six blocks of fourteen plots (seven cotton: seven millet) of 1/35·6 acre. Five-foot ridges, two rows at eighteen inches spacing, two plants per hole. Planted 9th December, 1952 (cotton); 8th January, 1953 (millet). Cropping rotation—two years' cotton: two years' millet.

Three Years' Treatments 1948–49 to 1950–51	Second Indicator Crops			
	Cotton		Bulrush Millet	
Treatments	Seed Cotton lb./acre		Grain lb./acre	
Annual cropping, residues carried off	822	100%	632	100%
Annual cropping, residues grazed	929	113	667	106
Cassava, weeded first year only	969	118	876	139
"Tumbledown" fallow—grazed	1,049	128	801	127
Planted grass fallow—not grazed	951	116	732	116
Planted grass fallow—grazed	1,061	129	854	135
Planted grass fallow—undersown with *Tephrosia* and *Crotalaria*—grazed	985	120	812	128
Sign. Diff. (P = ·05)	105	13%	121	19%
S.E.	±36·5		±41·8	

In Trial (5), Table 1, cotton and millet were second indicator crops. The trials are in two sections, half cotton and half bulrush millet; these are rotated. The benefits from the fallow rests were not so great as last year and there was little difference between "tumbledown" and the planted fallows. Legumes increased the fallow effects. Grazed treatments showed up slightly better this year than the ungrazed.

TABLE 2.—RESTING CROP TRIAL

Ukiriguru—Hill Sand—Trial (7)

Twelve blocks (six cotton: six bulrush millet) of eight plots of 1/48·4 acre. Five-foot ridges, two rows at eighteen inches spacing, two plants per hole. Planted 12th December, 1952 (cotton): 7th January, 1953 (millet). Cropping rotation—two years' cotton: two years' millet.

Five Years' Treatments 1947–48 to 1951–52	First Indicator Crop			
Treatments	Cotton		Bulrush Millet	
	Seed Cotton lb./acre		Grain lb./acre	
Annual cropping—no manure	1,185	100%	1,000	100%
Annual cropping—double superphosphate at 200 lb./acre applied 1952–53. Soda phosphate totalling 600 lb./acre applied in 1946–47, and 1947–48	1,729	146	1,207	121
Annual cropping—Compost at 6 tons/acre applied 1952–53. Farm yard manure totalling 7½ tons/acre applied in 1946–47, and 1947–48	1,704	144	1,472	147
"Tumbledown" fallow—grazed	1,770	149	1,251	125
"Tumbledown" fallow—not grazed	1,733	146	1,034	103
Planted fallow—grazed	1,501	127	1,132	113
Planted fallow undersown with *Tephrosia* and *Crotalaria*—grazed	1,658	140	1,304	130
Planted fallow undersown with local creeping legumes—grazed ...	1,662	140	1,111	111
Sign. Diff. (P = ·05)	147	12%	152	15%
S.E.	±51·1		±52·9	

Trial (7), Table 2, gives the first results from a similar trial started in 1947–48 with the resting treatments down for five seasons. In the cotton portion the yields after the "tumbledown" fallows are similar to the yields from the continuously-cropped plots which had received compost and phosphate dressings. With cotton the yields from the "tumbledown" fallows are slightly greater than from the planted fallows. Undersowing of legumes in the planted fallows has resulted in some increase. The story is not so clear-cut in the millet portion of the trial. As has been shown in earlier experiments, cotton and millet differ in their responses to treatments. The best responses in the millet portion of the trial were from the treatments where some nitrogen would have been added—the compost dressed plots and the grazed rests, especially those undersown with *Tephrosia* and *Crotalaria*. The local creeping legumes were not a success.

It is possible that the response to the "tumbledown" rest may be largely a *Tridax repens* story, as has been mentioned in previous reports. It is hoped that this and the other fertility problems will be clarified with the start of Mr. Le Mare's work on the chemical side of these Ukiriguru fertility experiments.

It has been seen that on the hill-sand soils land resting results in increased yields. It is quite likely that in these densely populated areas such as around Ukiriguru the occasional "tumbledown" rests on the hill sands, in years when

circumstances prevent full cultivation, are important influences in maintaining productivity and thus the population on the land. On the other hand on a station where a range of continuing experiments on exhausted land is desired it is something of an embarrassment when land intended for such experiments years hence has to be cropped annually merely to keep it exhausted.

At Lubaga early growth of cotton following a *Cenchrus ciliaris* grass rest was markedly better than in the plots with continuous cultivation but there was no increase in final yield.

Another Lubaga trial showed a profit in the second cropping year following *Cenchrus* rest but yields in this trial were very poor. The yield of cotton was depressed following *Chloris gayana;* in this treatment termites were very active and stands consequently poor.

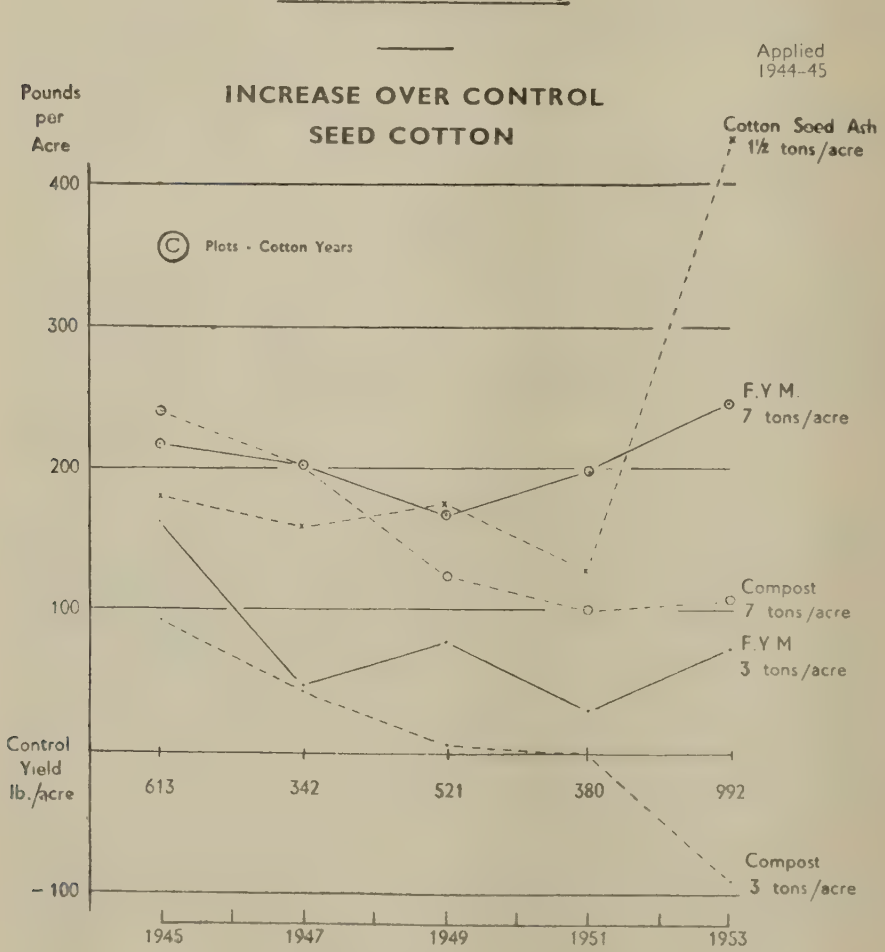


Fig 1. Residual effect of organic manures

TABLE 3.—MANURIAL TRIAL

Ukiriguru—Hill Sand—Trial (8)

Eight blocks of six plots manured in November, 1944. Half-plots, each 1/35·6 acre, were manured at the same rates in November, 1952, or received sulphate of ammonia at 175 lb./acre in March, 1953.

Five-foot ridges, two rows at eighteen inches spacing, two plants per hole. Planted 19th November, 1952.

Treatments	Yield seed cotton lb./acre		
	Ninth indicator crop	First indicator crop	
	Treatments applied 1944	Treatments re-applied 1952	Sulphate of Ammonia applied 1953
Control—no manure	992	—	882
Compost—3 tons/acre	900	1,151	—
Farm Yard Manure—3 tons/acre	1,065	1,189	—
Compost—7 tons/acre	1,098	1,362	—
Farm Yard Manure—7 tons/acre	1,237	1,537	—
Cotton Seed Ash—1½ tons/acre	1,424	—	1,604
S.E.	±55·0	±57·2	
Sign. Diff. (P=·05)	158	164	
Between treatments—in the same line	131		
not in the same line or column	165		

Interaction : Ash × Nitrogen ... ... +145 lb./acre
S.E. ... ... ±45·6lb./acre

In Table 3 are set out the results from the now nearly classical Trial (8), where residual responses are measured from organic manurial and cotton seed ash dressings applied in late 1944. The results in the five seasons when cotton has been the indicator crop are shown in Fig. 1. The results this past season were from the 9th indicator crop, cotton; in this trial cotton and millet are grown in alternate years. The 7 tons/acre F.Y.M. dressing was still showing over 200 lb. seed cotton/acre (24%) increase over control. This is as high a yield response with cotton as has been obtained in the nine years. The residual responses from the heavier compost dressing, and the lower F.Y.M. dressing, were not significant; the effect of the lower compost dressing had disappeared.

The striking residual response, an increase of over 400 lb. seed cotton/acre (43%), was from the plots dressed with cotton seed ash. (This cotton seed ash was reported to contain about 15%–20% P_2O_5. The dressing was a very much heavier phosphatic application than had been intended.) Till this season the cotton responses to this ash dressing had been of the same general order as to the heavier F.Y.M. and compost dressings. No theory can be offered why this season the residual response to ash should be so large. Reviewing the responses in this trial over the years cotton has shown higher residual responses to the ash than has millet.

Half of each of the organic treatment plots had the dressings reapplied this past season. The results are shown in Table 3. The reapplication of 7 tons/acre F.Y.M. resulted in a large increase over control, over 500 lb. seed cotton/acre, 300 lb. additional to the residual effects from the original manuring.

Sulphate of ammonia at 175 lb./acre was applied to one-half of each of the control and ash plots. Sulphate of ammonia had no significant effect on the control plots but increased the yields from the ash plots by nearly 200 lb. seed cotton/acre.

In Trial (9), Table 4, (Table 2, 1951–52 report) second residual responses were measured. The residual responses from the compost and phosphate dressings and the response to the reapplied nitrogen were of the usual order. There was no residual response from the nitrogen applied in 1952.

TABLE 4.—NPD EXPERIMENT

Ukiriguru—Hill Sand—Trial (9)

2 × 3 × 2 factorial, with NPD and ND interactions partially confounded, testing all combinations of:—

n_0, n_1, ... 0, 175 lb. sulphate of ammonia/acre.
d_0, d_1 ... 0, 6 tons compost/acre.
p_0, p_1, p_2 ... 0, 45, 90 lb. triple supers/acre.

Six replications in twelve blocks of six plots, each 1/69·7 acre. Compost and phosphate applied 6th–8th December, 1950; nitrogen applied 19th–20th March, 1951, 12th and 28th March, 1952, and 7th March, 1953. Five-foot ridges, two rows at eighteen inches spacing, two plants per hole. Planted 1st December, 1952.

SECOND RESIDUAL YEAR—NITROGEN RE-APPLIED

Mean Yields: Seed Cotton lb./acre.

n_0	...	...	...	...	1,366	p_0	...	1,370	d_0	...	1,366
n_1	...	...	...	...	1,568	p_1	...	1,486	d_1	...	1,568
						p_2	...	1,545			
Sign. Diff. (P = ·05)			...	...	84			103			84
S.E.	...	...	...	...	±29·5			±36·2			±29·5

Interactions												
	NP_2	...	...	...	+30	...	P_2D	...	−72	...	ND	...	0
S.E.	...	...	...	...	±51·2				±51·2				–

In Trial (23) where the direct response to phosphate last year was nil, this season in the second indicator crop there was no residual response to the phosphate. There were small residual organic responses; slight increases due to the application of sulphate of ammonia at different times were not significant. This trial is being discontinued. The general area is one of old house sites and it is felt that the lack of response to manuring treatments has been due to this.

In a new trial laid down on poorish soil, Trial (26), the treatments, 150lb./acre triple superphosphate and 6 tons/acre compost, resulted in similar yield increases, about 200 lb. seed cotton/acre, control 994 lb./acre; the combined phosphate–compost dressings together were little better than the separate applications. The top dressings of sulphate of ammonia, 175 lb./acre, applied at three different times had no significant effects on yield.

This lack of response to sulphate of ammonia is also noted in the Trial (23) results mentioned earlier and in the results from the top-dressing to the heavily manured portion of the Exhaustion Plot referred to later. Positive increases were obtained in Trial (9) where there was a considerable increase from the top-dressing and in the Lake Province Cotton Committee tests in the Bukumbi and Mwanza chiefdoms referred to later.

Half of the Exhaustion Plot growing the twelfth continuous cotton crop for demonstration purposes had had in 1951–52 very favourable treatment, 10 tons/acre compost plus two top-dressings amounting to a total of 250 lb./acre sulphate of ammonia. The first residual yield from this area, this 1952–53 season, was 1,297 lb. seed cotton/acre compared to 922 lb./acre from the untreated half of the original plot—now in fact the Exhaustion Plot. No increase in the treated half was recorded from a further top-dressing of 175 lb./acre sulphate of ammonia.

A very interesting set of results was obtained in a series of tests carried out by the Lake Province Cotton Committee applying superphosphate and sulphate of ammonia to African holdings in hill-sand areas around Mwanza. Ukiriguru has been associated with the work throughout particularly in analysing the results obtained. The trials were supervised by staff comparatively untrained in such work. It was a first attempt at an extensive test of this kind and many of the fields were not as uniform as was desirable. The results are remarkably consistent, they are statistically significant. Yields were good for African-grown cotton in the heavily cropped soils of the areas. Owners of the plots may have given them better attention than usual and all the plots used in the analysis were tie-ridged. Further, the sample areas recorded (twenty feet × twenty feet for each treatment) were selected for good average growth and stand. Ninety lb./acre double superphosphate were applied to just over 3,000 shambas; and of these just over 1,350 shambas had a portion of the phosphate area top-dressed with sulphate of ammonia 200 lb./acre. A large number of fields were discarded for various reasons. A total of 554 shambas was recorded; 317 in the Mwanza chiefdom and 237 in the Bukumbi chiefdom.

Over all the tests the mean increase was 145 lb. seed cotton/acre from the superphosphate application with an additional 206 lb./acre where sulphate of ammonia was top-dressed on the phosphated area. From Ukiriguru experience there should be two to three years' residual benefit from the phosphate but no residual benefit from the sulphate of ammonia. The cost of fertilizer applied would be approximately Shs. 40 - per acre for the superphosphate, and Shs. 55/- per acre for the sulphate of ammonia.

Using the mean control yield in each "gunguli" (a small administrative unit) as a measure of fertility there are indications that the response to phosphate was less with higher fertility and the response to nitrogen greater.

Yields of seed cotton in lb./acre.

	No. of Holdings	Control.	P	NP	Sign. Diff.	S.E.
All trials	554	794	939	1,145	25	±9·0
Chiefdom:			*Holdings grouped in Chiefdoms*			
Mwanza	317	860	1,019	1,272	35	±12·5
Bukumbi	237	706	831	974	33	±11·9

In 1953–54 residual responses are to be measured on just over a hundred holdings. Fresh applications are being made in a new series of trials.

Spacing and Time of Planting.—In two trials, one on rich land and one on poorer land, different spacings, times of planting, and times of application of nitrogen were compared. The times of planting—as so often must happen in practice—were unevenly spaced because of dry weather. The first two plantings early December and early January gave much the same yields; but there was a

very big drop with the March plantings. Wide spacing throughout gave a poorer yield than the closer normal spacing. The top-dressing of sulphate of ammonia, 175 lb./acre, gave a small but consistent increase in yield.

Ridging and Tying.—There are occasions when there is no immediate profit from ridging and tying as measured in increased yields as distinct from the general story of preventing soil loss; and in a very wet year on certain soils for some crops there may even be the suggestion of a yield depression. But this past season the benefits from ridge-tying were very apparent. At Ukiriguru the profit was much greater for cotton, longer growing than bulrush millet benefiting probably more from the holding of the rains of November, December and January.

At Ukiriguru in the cotton section of the main ridging trial, Trial (16), the good ridges tied gave 355 lb./acre more seed cotton than the poor ridges not tied—a 48% increase. In the bulrush millet section the increase was 100 lb./acre—only 10%.

TABLE 5.—RIDGING TRIAL

Ukiriguru—Hill Sand—Trial (16)

Ten blocks (five cotton: five bulrush millet) of four plots (ABBA arrangement) each 1/29·0 acre. Five-foot ridges, two rows at eighteen inches spacing, two plants per hole. Planted 24th November, 1952 (cotton); 12th January, 1953 (bulrush millet). Cropping rotation—alternate cotton and bulrush millet.

Treatments	Seventh year of treatments.			
	Cotton		Bulrush Millet	
	Seed Cotton lb./acre		Grain lb./acre	
Poor ridges—not tied	748 =	100%	1,018 =	100%
Good ridges—tied	1,103	148	1,119	110
Sign. Diff. (P=·05)	119	16%	100	10%
S.E.	±37·1		±31·2	

In a second trial, Trial (15), this season under bulrush millet there was again about a ten per cent increase from the tying (not quite significant).

At Lubaga in the "ibambasi", cemented hard soil, experiment where striking results have been obtained in many years cultivation on tied ridges gave around double the crop of both cotton and sorghum compared with cultivation on the flat—in spite of much poorer stands on the four-feet ridges. There was no difference in yield between three-feet and four-feet ridges. The cotton yields were low.

TABLE 6.—RIDGING TRIAL

Lubaga "Ibambasi" Soil

Twelve blocks (six cotton: six sorghum) of three plots of approx. 1/8·3 acre. Three-foot rows at twelve inches spacing; four-foot rows at nine inches spacing. One row per ridge, two plants per hole. Planted 21st–23rd January, 1953. Cropping rotation—alternate cotton and sorghum.

Treatments	Tenth year of Treatments	
	Cotton	Dobbs Sorghum
	Seed Cotton lb./acre	Grain lb./acre
3-foot—flat cultivation	233 = 100%	911 = 100%
3-foot ridges—tied	464 199	2,154 236
4-foot ridges—tied	375 161	2,118 232
Sign. Diff. (P=·05)	129 55%	461 51%
S.E.	±41	±146

In a second trial at Lubaga, on "ibushi", the old lake bed black loam soil, under Dobbs sorghum the increases from the ridge tying compared to flat cultivation were large. There was in this experiment no advantage from ridging without tying.

TABLE 7.—RIDGING TRIAL

Lubaga "Ibushi" Soil

Six blocks of five plots of 1/29·0 acre laid down in 1948–49. One row per ridge; spacing twelve inches in three-foot rows, seven inches in five-foot rows. Planted 27th November, 1952.

Treatments	Dobbs Sorghum	
	Grain lb./acre	
Flat cultivation—3-foot rows	647 = 100%	
3-foot ridges—not tied	589 91	
3-foot ridges—tied	1,210 187	
5-foot ridges—not tied	441 68	
5-foot ridges—tied	1,494 231	
Sign. Diff. (P=·05)	315 49%	
S.E.	±107	

The profit from ridge-tying in such a year balanced against the extra labour involved in tying and ridging should have been apparent even to the most indifferent cultivator.

Rotation.—Last year at Ukiriguru an increase in a rotation trial, Trial (19), of over forty per cent was recorded where cotton followed two years of bulrush millet compared to the treatments of cotton following cotton or with just one year of millet between. The suggestion made was that this "rotational" benefit might be due to a reduction in bacterial blight trash carry-over by rotation with cotton two years away from the previous cotton crop. This season with yields of cotton around 900 lb. seed cotton/acre and bulrush millet around 700 lb./acre there were no significant differences between any of the rotational treatments. With little bacterial blight and little infection from trash big differences due to bacterial blight trash infection would not have been expected.

In a similar trial at Lubaga the yield of sorghum following sorghum was significantly greater than the yield of sorghum following cotton and cotton following sorghum was possibly better, certainly not poorer, than cotton following cotton in the rotation.

On the granitic red hill soils such as round Ukiriguru productivity could be raised fairly simply in a number of ways—by resting land, by using organic manures, or by applying fertilizers and in most years there is profit in ridge-tying.

On the Lubaga black loam soil there is little response to manuring. There may be some benefit from land resting; but not to the extent that there is at Ukiriguru. There, and especially in seasons of patchy rain, the greatest contribution to increased productivity lies in ridge-tying.

COTTON BREEDING

A Uk. 53 was constituted and issued for first multiplication—approximately 2,700 lb. for growing by 169 growers. It consisted of 45 per cent of 8/290 and strains of 8/290 origin; 35 per cent of strains of 5/57 origin; and 20 per cent of strains of 7/150 and 6/318 origin.

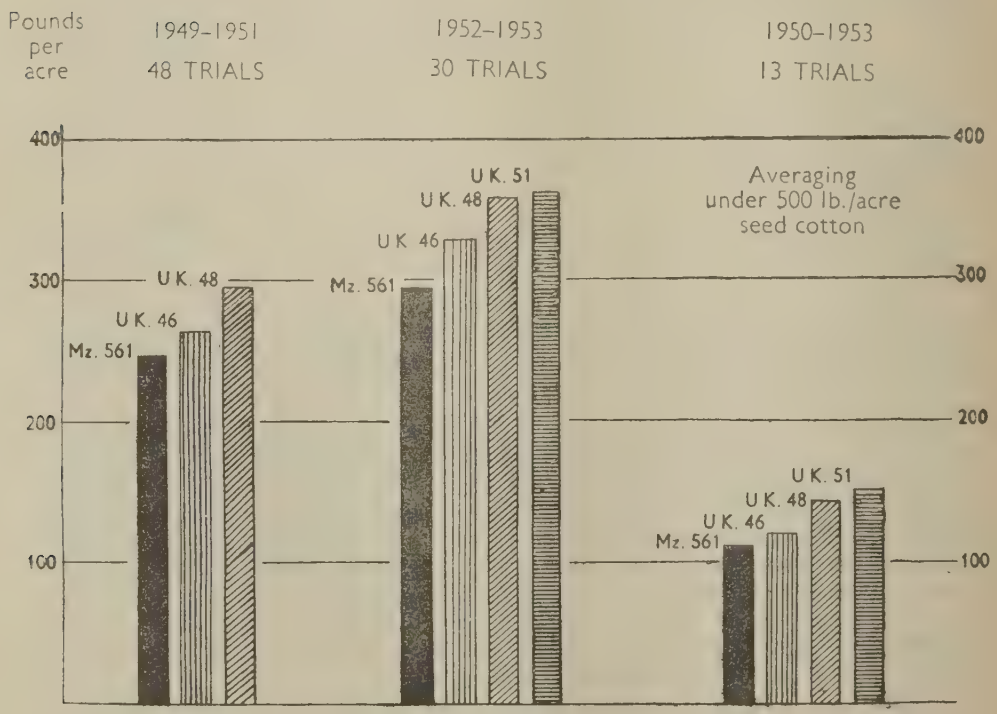


Fig 2. Lint yields 1949–1953

In Fig. 2 the lint yields over five seasons are illustrated from seventy-eight valid strain trials including the main trials at Ukiriguru and Lubaga and a scatter of district plot trials throughout the province comparing Mz. 561, Uk. 46 and Uk. 48; and over two seasons from thirty valid trials, comparing Uk. 51 with the earlier issues. Lint yields are shown for three seasons from thirteen of these trials where seed cotton yields were averaging under 500 lb./acre. Taking the 1949 51 series of trials, Uk. 46 was up 7 per cent, and Uk. 48 up 21 per cent on Mz. 561. Taking the 1952/53 series of trials, Uk. 46 was up 11 per cent and Uk. 48 up 22 per cent on Mz. 561, with Uk. 51 yielding about the same as Uk. 48. The yield level over the seventy-eight trials was good. Taking the low yielding series of trials the relative increases are of the same general order but rather better: 28 per cent up for Uk. 48, and slightly better for Uk. 51. (The largest yield differences were in 1952 when for example in the main station trials Uk. 48 was 40 per cent up on Mz. 561, 16 per cent up on Uk. 46, with Uk. 51 yielding slightly better than Uk. 48.)

The two Ukiriguru hill sand strain trials this past season yielded at a high level, the mean control yields being 1,900 lb. seed cotton/acre. Mz. 561 was 13 per cent down in lint yield on Uk. 46 in the one trial where Mz. 561 was included. There were no differences in yield between Uk. 46, Uk. 48 and Uk. 51 in either trial; and in both trials there were only a few significant strain differences compared to Uk. 46, the control. Some 7/150 segregate strains were significantly poorer than Uk. 46 in both trials. In the Lubaga strain trial yielding at the 700 lb. seed cotton/acre level there were no significant yield increases over the control, Uk. 46. No theory can be offered why there should be such small yield differences this season. The Ukiriguru "mbuga" trial was too uneven after repeated re-plantings to allow of comparative yields being measured.

District plot yields as a whole were variable and not particularly good. Two plots could not be planted for lack of rain; one was practically a failure; four were cropping at around 300–350 lb. seed cotton/acre; two at around 750 lb. seed cotton acre: one at around 850 lb. seed cotton/acre; five at around 1,000 lb. seed cotton acre, and one at 1,350 lb. seed cotton/acre. Uk. 48 averaged 9 per cent up on Mz. 561 in lint yields; the highest increase on Mz. 561 was 15 per cent. The best yielding strains were 7/9 and 7/14 ex 5/57 and 8/290.

There were reports of scattered minor jassid damage; but jassid was not a factor influencing any of these trial yields.

Ginning Percentage; Seed Weight.—Fig. 3 shows ginning percentage and seed weight variations for the past four seasons and gives a comparison of ginning percentages and seed weights between Mz. 561, Uk. 46, Uk. 48 and Uk. 51 from replicated trials. The story is generally consistent, with Uk. 46 around 1·5 per cent higher in ginning percentage than Mz. 561, sometimes more; Uk. 48 around ·5 per cent better; and with Uk. 51 giving about the same ginning percentage as Uk. 46. The variations from season to season are important administratively; they can be partly but not wholly linked with variations in seed weight. Variations also occur between ginnery zones in the same season not following a consistent pattern nor explained only by variations in seed weight.

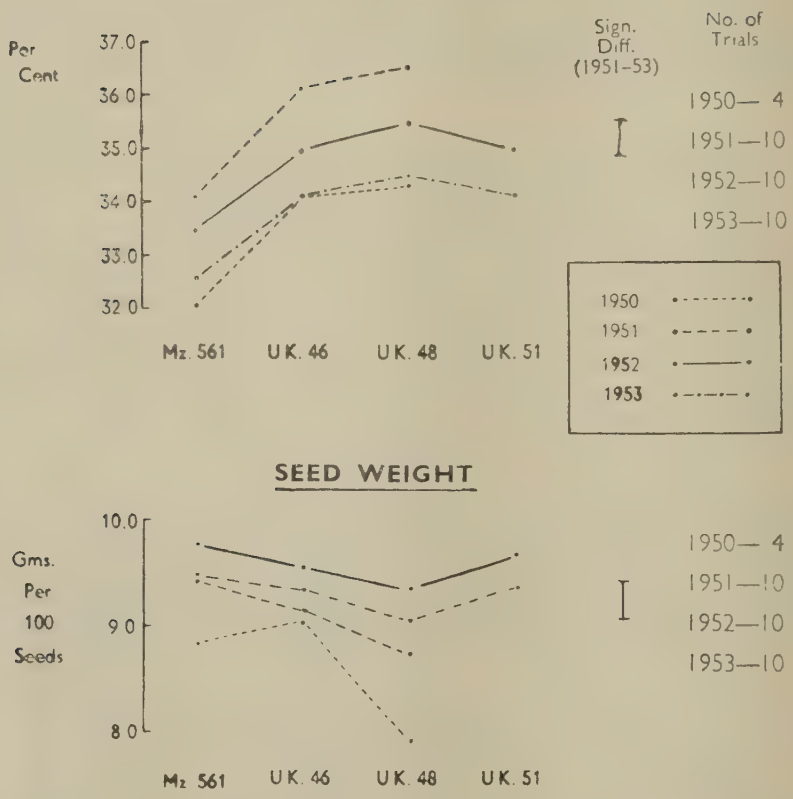


Fig 3. Ginning percentage and seed weight

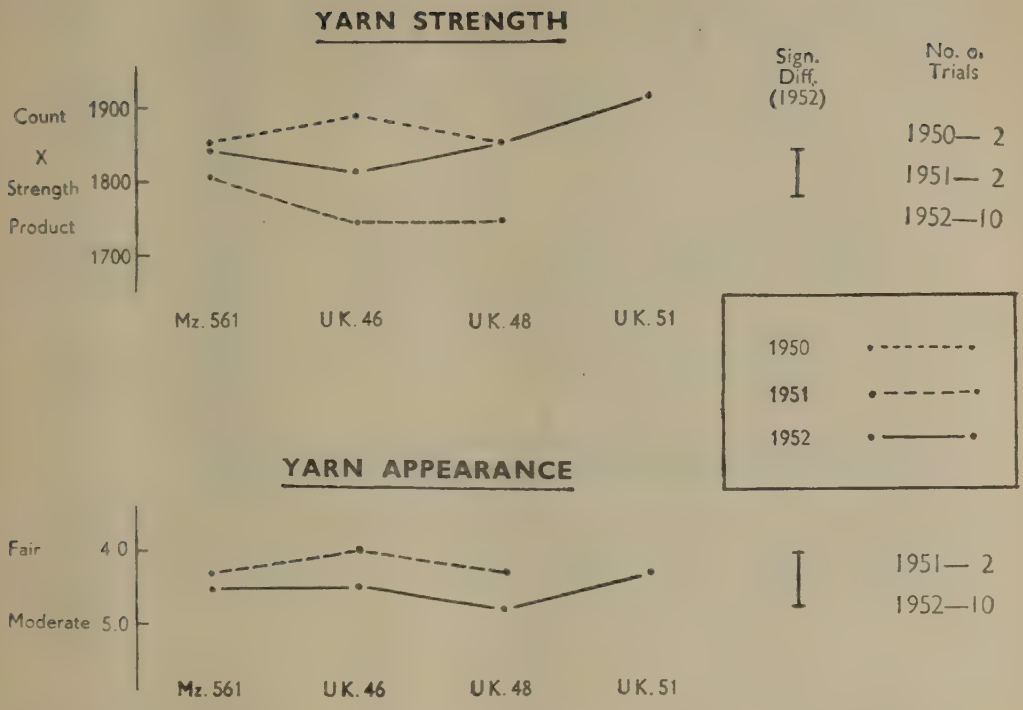


Fig 4. Yarn characters

Spinning Tests and Yarn Appearance Reports.—Fig. 4 illustrates the Shirley Institute Count × Strength Product results for three seasons, for Mz. 561, Uk. 46, Uk. 48, and Uk. 51; and Yarn Appearance gradings for two seasons. The results are from replicated trial material from large and small scale spinning tests.

As always we are very greatly indebted to the Shirley Institute for these spinning tests and reports.

It will be seen that the spinning qualities of the several seed issues remain similar; but that there is the suggestion of slight improvement in the quality of Uk. 51.

We await with great interest Mr. Evenson's further experimental testing of a range of our material at Namulonge—more particularly the grading for percentage of seed coat damage and chalazal tuft immaturity grading, linking up—possibly anticipating and explaining variations in spinning qualities.

Crossing Programme with Albar 51.—The crossing programme with Albar 51 continues the most important part of the breeding programme. It is turning out less straightforward than we had perhaps rather optimistically hoped. We are

still assessing defects and qualities in the Ukiriguru material more particularly in spinning and yarn appearance. The qualities of the Albar 51 segregates are still comparatively unknown. But the adding of bacterial blight resistance to Ukiriguru stocks is of such importance that it seems worth-while continuing a large crossing programme, anticipating a considerable amount of discarding, rather than waiting for a more exact appreciation of the qualities of the Albar segregates before starting work.

Both in the Albar 51 segregates and in the new hybrid progenies a considerable proportion of "unbalanced" types have been showing up. Such plants wilt at any stage from young plants to fairly mature plants with opening bolls and if left eventually die. The defect appears to be physiological.

First and second back cross progenies are now growing and selfed lines from the most promising hybrid material.

Selection for bacterial blight resistance is based on reaction to (a) seed inoculation and (b) stem inoculation using Wickens' needle prick technique.

The most promising material is grown out-of-season with hand watering, planting in June–July and picking November–December, thus gaining an extra generation.

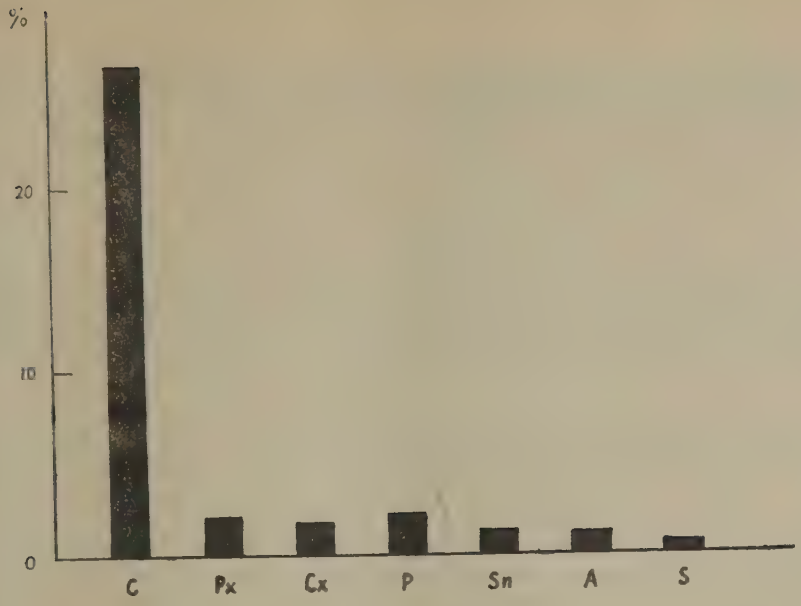
DISEASES AND PESTS

Diseases

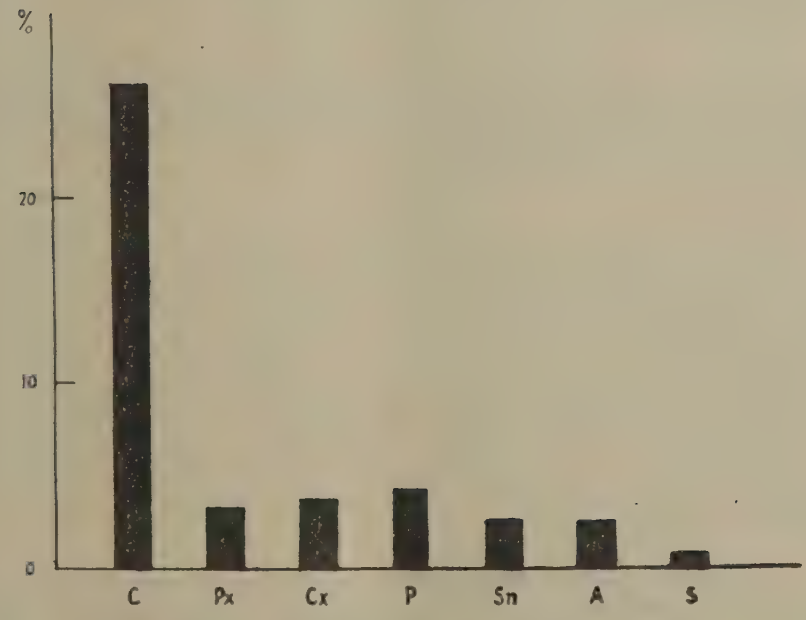
Bacterial blight (*Xanthomonas malvacearum*).—Observations on the severity of bacterial blight over the past nine seasons show that damage caused by the disease last season was the lightest recorded. There was a light attack in 1948-49 but in the remaining seven seasons the general attack ranged from severe to very severe. Both light attacks have occurred in seasons of exceptionally low and unevenly distributed rainfall.

In spite of the lack of damage to the crop caused by bacterial blight the disease was of universal occurrence. Most plants showed some angular leaf spot and small restricted lesions on stems, branches, and peduncles. Boll infection was at a high level and was particularly noticeable towards the end of the season. The most frequent point of infection was at the base of the boll causing yellow staining of the points of the locules.

In a trial at Ukiriguru to investigate the control of seedling infection by chemical seed treatment a marked reduction in the early stages of infection was observed following treatment with a range of chemicals. Some of the results are shown in Fig. 5. The data summarized in diagram (a) were transformed for analysis using the function $y = \log(x + c)$. The analysis showed that sulphuric acid treatment was more effective than treatment with Perenox ($P < .05$); the observed improvement of Spergon and Agrosan over Perenox approached significance at the 5 per cent level. The comparison between control and treatments was highly significant in all cases. Diagram (b) is based on data obtained from thinnings. The plots were thinned by labourers in the normal way and there may have been some bias towards removing the worst plants.



(a) Percentage of seedlings showing cotyledon lesions at 3–4 weeks after emergence.



(b) Percentage of thinnings showing stem lesions at 6–7 weeks after emergence.

Fig. 5. Control of Bacterial Blight by Seed Treatment.

The seed was naturally infected fuzzy seed (UK.46). Dusts were applied at the rate of 1 :300 w/w. Treatment with sulphuric acid was carried out in the normal ways. Mean number of plants scored per treatment :—(a) 1,146, (b) 298.

C. Control, untreated.
Px. Perenox.
Cx. Cupromox.
P. Perecot.
Sn. Spergon.
A. Agrosan.
S. Sulphuric Acid.

Later observations showed that the early control of bacterial blight gradually disappeared as infection spread through the plots and across the guard rows. The trial was planted on land which had carried cotton in the previous season and it is possible that there was infection from trash.

The experiment, though not designed to measure yields, was harvested as a yield trial. At the first picking the treatments outyielded the controls by a mean level of 25 per cent. ($P<.05$). The total yields however were irregular. Yields of individual treatments were not correlated with the degree of bacterial blight infection recorded at the seedling stage and the final mean yield of the treatments was not significantly above that of the controls. (The trial consisted of twelve seed treatments and two controls in randomized blocks, eight replications).

It was also possible to observe the effects of seed treatment with Perenox under conditions of native cultivation. Two hundred tons of seed which had been treated in Uganda were planted in part of Mwanza District chiefly on rotated fields. The boundary between the zones of treated and untreated seed passed through the area covered by the Lake Province Cotton Committee fertilizer experiment. Yield figures were taken from 150 treated plots and 107 untreated plots in one area where climatic and soil conditions were similar. From these figures no increases in yield due to the seed treatment could be detected. Similar observations are to be made in the coming season; the indications at the time of writing are that the damage caused by bacterial blight will be greater than that observed last season.

Wilt Disease.—A wilt disease was again observed at Lubaga in cotton growing on land which had been under grass for the previous three years. Affected plants showed severe wilt symptoms and brown staining of the vascular strands. The pathogen has not yet been identified.

Pests

American bollworm.—American bollworm loss was small though there were reports of loss in some areas. At Ukiriguru there were American bollworms on ensilage maize in mid-March; and at that time bollworms were also reported in native maize crops adjacent to Ukiriguru. There was a very small American bollworm attack on cotton at the end of April. In mid-May very considerable populations were recorded on a field of bulk maize but there was very little attack then on cotton, even nearby cotton. The maize had attracted the egg-laying moths. Populations of the same order on cotton as on the bulk maize would considerably have reduced Ukiriguru yields. (In the 1953–54 season maize plantings have been planned to try to give as far as rains permit a succession of cover from tasseling maize).

A very interesting observation recorded by the botanist on sorghum has been that American bollworms are very frequently found in heads bagged for selfing. But only very occasional larvæ are found on unbagged heads of the open-panicled types; some are found on tighter panicles. Insectivorous birds may be destroying the larvæ on the open panicles. Unfortunately at least in parts of the province the activities of grain-eating birds may make it difficult to grow open-panicled palatable early sorghum types which might well act as traps for the early American bollworm generations.

Spiny Bollworm.—A few Spiny bollworms were reported on Ukiriguru; and there were reports of early scattered damage by Spiny bollworms in the districts.

Pink bollworm.—Occasional Pink bollworms were reported at Ukiriguru towards the end of May. None was observed in the out-of-season crossing material until the end of January, 1954 when a few specimens were found. As soon as these were discovered the remaining plants were uprooted and all trash was burned.

Stainers.—At Ukiriguru stainers were observed in cotton by early March—mainly *D. superstitiosus*. Numbers increased through the season; by late June there were fair populations, mainly *D. fasciatus*. There were fair Callidea populations in and out of the crop in May and June.

In the out-of-season planting, populations built up in mid to late November 1953, mainly *D. fasciatus* with some *D. nigrofasciatus*. At the end of November the plants were dusted with Toxaphene. Later after a further build-up of *D. fasciatus* and nymphs plants were again dusted.

At Lubaga and in the Shinyanga District plots where in many years stainer damage is the most important factor affecting the cotton crop stainer damage this season was severe. At Lubaga from March onwards there were considerable populations, mainly *D. fasciatus*, breeding in the crop. The first picking at Lubaga showed 30 per cent Grade C; for the whole picking the percentage of Grade C was 40 to 50 per cent. The Shinyanga District plots showed even a higher percentage of Grade C, around 60 per cent. It is hoped that arsenic and sugar poisoning can be tested more thoroughly in the 1953–54 season.

At Ukiriguru the percentage of Grade C varied around 10 to 15 per cent. The percentages from the district plots in the Lake shore area and middle interior were generally under 10 per cent. In these areas including Ukiriguru possibly there has not been sufficient emphasis on the influence of the bollrot phase of bacterial blight on the amount of Grade C cotton. It would be fairly safe to say however that in Southern Sukumaland the predominant influence is stainer and Callidea damage.

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Deputy Senior Officer, East Africa

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Plant Breeder

M. H. Arnold,
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APPENDIX

Origin and Special Characteristics of the Main Cotton Strains Mentioned

Lake Province	"Local." The commercial cotton in the Province prior to the issue of Mz. 561—mainly of Uganda Local origin.
Mz. 561	A straight selection from "local", first multiplied in the 1939–40 season.
Uk. 46	A seed issue with fair jassid resistance made up of the four best Ukiriguru strains and the three best Lubaga strains available at the time, first multiplied in the 1946–47 season.
Uk. 48	A seed issue made up of four strains of better jassid resistance than Uk. 46 first multiplied in the 1948–49 season.
Uk. 51	A seed issue made up of seven strains with jassid resistance, first multiplied in the 1951–52 season.
Uk. 53	A seed issue made up of eleven strains, first multiplied in the 1953–54 season.
5/57	A derivative of 3/17, itself a straight selection from "local".
6/318	Ex 4/35, itself a derivative of Mz. 561.
6/320	Ex 4/35, cousin strain of 6/318.
7/9, 7/14	Ex 5/57.
7/150	Ex 3/28; having high jassid resistance.
8/290	Ex 6/320; one of the heaviest cropping Ukiriguru strains.
Albar 51	General term for 1951 selections from Nigerian Allen, highly resistant to bacterial blight; ex Dr. J. B. Hutchinson.

SUMMARY OF ANNUAL REPORT OF THE ILONGA AGRICULTURAL STATION (EASTERN PROVINCE) FOR THE YEAR 1953

Weather

The short rains failed almost completely and the main rains did not commence until after mid March. Distribution was however good and continued later than normal up to the end of May. Rainfall for the season (October–September) amounted to 32·84 inches (average over past eight years being 41·04) and was 35·12 for the whole year.

Cotton

During the latter half of March, 107 acres of the new variety 47/10 were planted in order to build up a larger seed supply. Germination was uneven due to lack of soil moisture but some seventeen acres of the total which were mechanically planted after seed treatment proved very successful. The incidence of American bollworm was not so heavy as in the previous year yet the value of dusting with insecticide was very noticeable. Where adequate treatment had been received the setting of bolls was even and complete. The variety 47/10 tends to produce too big a plant on fertile land. One twenty-acre block could not for physical reasons be sufficiently treated with insecticide, in consequence yielded only 30 lb. per acre of seed cotton whereas other fields gave up to 610 lb. per acre.

Maize

Forty-seven acres of white Katumbili and fifteen acres of Eckstein yellow short-term maize were sown on the ridge; an experiment in the previous year having shown conclusively that crops grown on the ridge gave far higher yields than those grown on the flat. With the exception of one hand weeding in the row and singling the acreage was treated mechanically thereafter and good yields were obtained (2,146 lb. per acre) and this in a poor year showed the superiority of the methods used. A third of this acreage was handled with a mechanical picker but as the balance of this area was badly laid by high winds and game it was harvested by hand. Indications in trials were that maize planted on the flat tended to become laid more easily than that planted on the ridge.

The adaptability of Katumbili maize was shown by the fact that eleven acres of the above were sown in early February and due probably to the deep cultivation it had received and the ridging of the land the little rain which did fall was completely absorbed and the plants withstood a six weeks drought while less than a foot high. Tasselling took place seventy days after sowing and practically the same yield was produced as the remaining maize which was planted from mid March onwards and which tasselled after only forty days.

The demand for seed far exceeded the supply of eight and a half tons of selected and nineteen and a half tons unselected seed which was eventually distributed.

Indian Millet

Panicum milleaceum.—Results from the small acreage planted to this crop were very encouraging and despite the fact that it was not sown until the beginning of April and that some shattering took place a yield of 1,178 lb. per acre was obtained. It gave promise of being a suitable short rains catch crop capable of producing a good ground cover when needed while at the same time smothering weed growth. The crop was harvested by combine.

Rice

Yields were very good. The variety sown late in February and with a corn drill was Kahogo. The crop was combine harvested in mid July and yields of 2,017 lb. per acre were obtained and the whole of the crop was disposed of locally as the native rain-grown rice had failed completely.

Cassava

Bulking of some of the more promising of the twenty-one Amani mosiac resistant varieties was started in early February and results to date are encouraging. While it appears that there is no type completely immune to local strains of the disease a number grow strongly in spite of it. Local types of cassava and the bitter variety "Liongo" from the Western Province are susceptible but whereas the former produces little crop the latter gives yields comparable with the best of the Amani strains in spite of the disease.

Other Crops

Beans planted in newly cleared land at the beginning of May gave promise of excellent yields but due to dessicating winds which followed the rain when pods were beginning to form reduced the yields to an average of 529 lb. per acre. Crops were however superior to any grown by natives on a similar scale in the neighbourhood. Chick pea produced reasonable yields despite a heavy attack by American bollworm and provided useful material for mass selection.

The planting of green gram was unavoidably delayed and the crop probably for this reason suffered from a heavy attack of powdery mildew. The main object, that of producing a seed supply for the following year, was however achieved. Cow pea was a complete failure as was also the small plantings of groundnuts.

Plant Breeding Experiments and Observation Plots

Cotton.—The ninety-six single plant selections made in 1951 were planted out in March in plots varying in size from $^1/_{25}$ to $^1/_{10}$ acre according to the seed available. From these 196 of the most promising selections were taken for further trial. Twenty-four selections made prior to 1949 were planted in larger plots totalling ten acres in all for bulking for observation and ginning tests, which, due to the cotton breeder's illness could not be carried out.

An eight-acre insecticide trial revealed that the application of 10 per cent DDT and 3 per cent Gamma B.H.C. in talc gave significantly better results at seven-day intervals at eight and sixteen lb. per acre respectively than either rate of application at ten-day intervals. There was no significant difference between the two rates at either period of application. Yields varied from 46 lb. of seed cotton per acre in the control to 880 lb. of seed cotton per acre in the best treatment. The optimum significant yield obtained with 56 lb. of insecticide per acre represents a worthwhile economic advance on methods previously tried.

An acre plot of 47/10 cotton grown for observation only gave a much higher yield than an adjacent and similarly treated plot of local cotton.

Maize

The two best crosses of Eckstein maize made in 1952 according to Harland's method of plant improvement were planted out in a strain trial towards the end of March. Several cobs of each were self-pollinated to keep the strain pure and those of the eight best yielding strains will be retained for crossing in pairs. This method suffers from the disadvantage that the initial material was very heterogeneous with a high proportion of dent characteristics. This factor seems to be associated with the long-term high yielding characteristics. The strain trial therefore merely selected long-term dent maize from the mixture and neither of these characteristics are desirable. It would be more satisfactory to begin with material which is less variable for characteristics other than yield. Nine hundred and twenty lb. of the heaviest cobs containing the flint and short-term characteristics were selected from good plants of Katumbili maize as a start towards improving the variety by Brieger's method.

Sorghum.—Each of the seven varieties—including two strains of Dobbs received from different sources—which had been the most successful in 1952 were planted out in a seed rate spacing trial at the end of March. Two of these, Oklahoma and Roma White, failed almost completely and it is suspected that the seed had been previously damaged by mould. The remainder gave excellent yields. The two Dobbs, Enyanza and Kano, showed that seven inches spacing between the drill rows gave significantly much higher yields than fourteen inches and twenty-eight inches spacing at either seed rate. There was no significant difference between six lb. of seed per acre or twelve lb. per acre at seven inches spacing but the difference between the equivalent rates at the other spacings was significant though not as large as the difference due to spacing.

A similar experiment with Early Shallu at fourteen inches and twenty-eight inches spacing and six lb. and twelve lb. of seed per acre was based on a different conception in that the actual seed rates per acre were the same at each spacing and not proportioned so as to give the same amount of seed per length of row. The results of this were more difficult to interpret but they seemed to indicate that an optimum yield could be reached at twenty-one inches spacing using the heavier seed rate.

In order to try and assess the fundamental reasons for the change in yields the number of head were counted on all plots. These showed that significant reduction in head size only occurred at the closest spacing and heaviest seed rate. Up to that point there was evidence of a trend in the reverse direction possibly due to reduction in tillering and consequent increase in size of the main head.

Seed of twenty-seven varieties obtained from different sources was planted out for purpose of observation. Some heads of each type were bagged to prevent cross pollination. Germination in some cases was very poor and without exception the double dwarf varieties lodged badly. This was undoubtedly partly the result of stalk borer attack.

Other Crops

Beans.—Selections made in 1952 and a number of types selected from local mixed beans were planted out for observation. Yields were poor due to heavy bean root fly attacks and the unavoidable lateness in sowing. Observations may lead to the development of suitable types for combining in the future.

Velvet Beans.—Small plots were established for observation and seed bulking. It was observed that the black seeded variety stayed green for a much longer period during the dry season and gave a greater yield than the brown mottled variety. A selection was made from the latter of a type which might be useful for combining.

Castor.—An observation plot of dwarf varieties from South Africa was established. There was a good deal of loss due to a blight. The remainder yielded well and individual plant selections were made. These were subsequently planted under irrigation during late September. Trials are to be continued.

Observation plots were also planted to loofah, kudzu vine, lucerne and manila beans. The manila beans were found growing well in an area formerly under native cultivation. Though it is not known whether it is indigenous or was introduced it effectively competes with and smothers buffalo bean and the local natives regard an area covered with it as useful for cultivation in that it is free of weeds and in good condition and the plant itself is easily eliminated. Seed has been collected for trial as a fallow crop.

Tillage Trials

An experiment with maize as the indicator crop to compare the effects of hand cultivation, early, late and double ploughing showed that all three types of mechanical cultivation were significantly superior to hand cultivation. This appeared to be due to greater penetration afforded to moisture by the former in a dry year. Double ploughing was significantly inferior to either early or late ploughing which were not significant between themselves. This was to be expected in a dry year.

Pests and Diseases

American bollworm was as usual the limiting factor in the cotton crop and where control was effective as in the best treatments of the insecticide trial yields were good. In addition to reducing yields this pest was responsible for more low grade cotton than was stainer. Incidence in 1953 was high but not as high as in 1952. The tips of most maize cobs were also damaged by American bollworm. Spiny bollworm did comparatively little damage but after following the American bollworm population curve during the season it began to build up again towards the end of the season on those plants which were producing new flowers. Pink bollworm damage was insignificant. Damage due to stainers was less than usual although they were present in fairly large numbers. *Oxycarenus* spp. were present in very large numbers and all lint had to be spread in the sun in order to disperse them before ginning could take place. Some damage was caused by stalk borer in the late-planted sorghums particularly in the plots of the double dwarf varieties.

Pucinia polysora was present on maize but caused little damage and the powdery mildew *Erisipne polygoni* attacked the green gram and cow pea.

Porcupine were successfully eliminated by poisoning but pigs caused considerable damage to maize and cassava.

Bush Clearing and Soil Conservation

Forty-two acres of heavy riverine bush were cleared by hand during the year and were planted to maize and beans. A further sixteen acres were similarly cleared towards the end of the year for cropping in 1954. Two hundred and eighty acres of light to medium bush were mechanically windrowed. Wind breaks were left around each block of cleared land and will be used as waterways to take the run-off from roads and headlands. Several miles of ditches and banking have been mechanically constructed to divert run-off from the surrounding hills.

District and Seed Bulking Plots

District plots totalling twenty-three acres were established at seven different places in the province to compare the selection 47/10 with the local strain of cotton under as diverse conditions as possible. These were not treated with insecticide. In general 47/10 outyielded the local variety. A group of natives with an acreage totalling 220 acres supervised by the Tanganyika Cotton Company planted 47/10 for bulking seed in addition to that grown at Ilonga. The bulk of No. 1 seed produced in all areas will be sufficient to plant some 5,000 acres of this variety in 1954.

D. F. Phillips,
Agricultural Officer i/c.

COLONIAL AGRICULTURAL INSECTICIDE RESEARCH UNIT, ILONGA, 1953

Following the successful results of small-scale experiments at Ilonga Research Station in the control by insecticides of American bollworm in cotton, a three-year scheme for research into insecticides and their application to peasant crops was started in 1953. Seventy-five per cent of the cost of this scheme is being met from a Colonial Development and Welfare Research grant, 12½ per cent from the Lint and Seed Marketing Board and 12½ per cent from Territorial funds.

Due to delays in the arrival of staff no field work was possible in 1953 but the collection of equipment and materials and the building of the necessary accommodation was largely completed and will enable a start to be made in the 1954 crop season.

While the unit will pay particular attention at first to further research on insecticides for the control of American bollworm in cotton and the design and improvement of suitable equipment for their application especially in peasant agriculture the programme is also intended to include work on stalk borer in maize and sorghums and other important pests of annual crops. The scheme was expanded in 1953 to include large-scale field trials of the control of these pests, as well as *Theraptus* in coconuts by appropriate machines including the use of aircraft. The supplementary scheme is financed entirely by a Colonial Development and Welfare Research grant.

COFFEE RESEARCH STATION, LYAMUNGU, MOSHI, ANNUAL REPORT FOR THE YEAR 1953

Weather

The average rainfall for the last twenty years (1934–53) is 63·45 inches; in 1953 47·89 inches were recorded. During the first quarter precipitation was very light; amounting to only 3·7 inches compared with an average of 8·53 inches; only one day's rain was recorded throughout February. The long rains produced 29·74 inches but ceased abruptly at the end of the first week in June after which hot sun was experienced. Thereafter only small amounts were recorded but during the last quarter there were alternating periods of rain and hot sun.

Crop

Owing to the prevailing weather conditions the crop season was greatly extended, the main pickings being at the end of October and throughout November, six to eight weeks later than usual. "Fly" picking had commenced at the end of April and picking was still going on at the close of the year. Cherry equivalent to an approximate total of seventy-six tons of parchment coffee was harvested from a total cropping area of 126·75 acres. The early pickings produced very small beans as was the case throughout the Northern Province but normal sized beans came in with the main crop.

Station Experiments—General

Owing to the unsatisfactory rainfall it was necessary to resort to irrigation three times during the year. The young coffee in Experiments IIIB (Clones v. Seedlings), XVIIIA (Clonal Selection trials), and XXI (Methods of Pruning) was irrigated in February, June, and August. Experiment XX (Time of Pruning) was irrigated in February and Experiment XVIII (Clonal Selection Trials) both in February and August. Other experiments were also irrigated in August.

Rain in late March and early April brought out a heavy flowering in Experiments II (Seedling Selection), V (Mulch, Compost and Nitrogen) and XV (Irrigation and Mulch), but fruit setting was poor and some dropping of newly-formed cherry occurred presumably as a result of heavy rain at the time the flowers opened and immediately afterwards. This possibility is being tested by means of an artificial spray of water on flowers as they open.

During the last three months of the year all available labour was engaged in picking or in the factory. The intermittent rain and hot sun during this period resulted in heavy weed growth which could not be controlled owing to the lack of labour. This fact combined with the heavy crop and severe outbreak of *Hemileia vastatrix* (Leaf rust) resulted in severe defoliation of some trees especially in Experiment XVIII (Clonal Selection Trials). A certain amount of die-back has resulted.

One new experiment (XXII) was planted in April. This experiment is designed to test the effect of irrigation plus mulch on seedling material of a series of selections grown on both the single and multiple stem systems; three modifications of each pruning system are allowed for.

Individual tree recording was commenced on the seedling progeny of further selections in Experiment II (Selection Garden).

Although the final results are not yet analysed provisional figures for 1953 from Experiment XIX (using an arbitrary sixteen per cent out-turn figure) confirm the findings of 1952, namely that the presence of interplanted bananas depresses yields. In fact, taking a mean of the two years' yields where bananas are planted at the rate of 135 stools to the acre the coffee yields have been halved compared with those plots without bananas. It must be emphasized however that these results are for two years only. The coffee is grown on the multiple stem system. Another interesting feature of this experiment is that manure applied at the rate of one *debe* per tree (and per banana stool) has always increased yields over no manure treatment, but where two *debes* have been applied yields have been depressed below the level of those with one *debe* though not so low as the controls. These differences are not always significant. Thus there is the same tendency here with manure as there has been with mulch in Experiment XV (Irrigation and Mulch), namely that the greater dose has generally depressed yields below the level of the lesser dose. With compost in Experiment V there has been no difference over a period of eleven years between the greater and lesser doses.

Further examination of the yields over fifteen years from Experiment XIII (Method of Pruning) shows that the big differences in yield between multiple stem (three suckers) and single stem can be attributed to the results of the first seven years in the field, i.e., before the single stem trees have reached maturity. The following table shows the yields divided up in this way :—

SUMMARY OF RESULTS FOR EXPERIMENT XIII

Yields in cwt. clean coffee per acre

	Multiple Stem Agobiada	Multiple Stem 3 suckers	Single Stem	Mean	Std. Error	Signif. Difference (P=·05)
Mean Yield 1939–43	7·31	11·51	4·85	7·89	0·35	1·20
Mean Yield 1944–52	9·92	11·35	10·89	10·71	0·298	1·03

Thus, from the yield point of view the real advantage of multiple stem lies in its ability to yield heavier crops at an early age. The exception to prove this rule however is found in Experiment XVIII (Clonal Selection Trials) where the clone H. 66 on single stem yielded at the rate of 20·28 cwt. clean coffee to the acre in its fourth year in the field with a mean of 11·13 cwt. after seven years in the field. Future planting of progeny of selections on both single and multiple stem may help to elucidate this point.

The preparation of land for two new experiments to be planted in 1954 was undertaken. These are (1) a spacing trial embodying further treatments and (2) a selection trial using single tree plots of seedlings with two clones as "keys" and thirty selections in all. The site for these experiments had been previously planted with elephant grass, giant cynodon, and *Pennisetum salifax*. Great difficulty was experienced in eradicating quickly by mechanical means the two former grasses. The persistence of a *Cyperus* sp. added to the difficulties.

By means of clean-felling the bananas additional trash was made available and it was possible to mulch twenty-seven acres of coffee with this material in February and March. Heavy weed growth later in the year unfortunately impeded regeneration of the bananas.

Some trials were conducted with Sodium trichloroacetate (T.C.A.) to test its effectiveness as a weedkiller on "couch" grass (*Digitaria scalarum*). The results were not entirely satisfactory and a further revision of the rates of application and or the number of applications is necessary. When applied to the ground in the vicinity of coffee trees at a rate of fifty lb. to the acre some distortion of the leaves of the coffee trees was noticed after an interval of fourteen days. At lower rates of application this effect was not noticeable.

Nurseries

Cuttings.—The monthly planting experiment was continued; no other experiments were undertaken. The rooting of cuttings continued for the following purposes:—

(a) To supply existing experiments;
(b) To produce clonal material as "keys" for new selection trials;
(c) To establish mother-trees of new selections.

Grafting.—With the object of gaining information regarding compatibility a number of trial grafts were made on miscellaneous rootstocks using the clone N. 39 as the scion. Unfortunately wet weather ensued each time before a satisfactory union had been effected; the result was excessive "bleeding" of the stock and subsequent rotting of the top of the stock causing the death of the scion.

Seedlings.—Extensive new nurseries were prepared and seed was sown for the two new experiments mentioned above. Seed of some twenty-seven new introductions was also sown.

Breeding

A preliminary breeding programme was started. Reciprocal crosses of H. 66, KP. 423, and N. 39 were made; in addition all three were crossed with *C. arabica*, var. *Geisha*, which appears to have a high degree of resistance to *Hemileia vastatrix*, and with *C. arabica*, var. *Amphillo*. Fruits from all these were harvested and the seeds were prepared.

Towards the end of the year both N. 39 and KP. 423 were crossed with *C. arabica*, var. *Geisha* and with *C. salvatrix*, also apparently resistant to leaf rust. An experiment was also undertaken to test the efficiency of the present methods.

Factory

Alterations carried out to the old factory included the housing of the engine and pulper in a new building adjacent to the former one and the extension of the pre-fermentation washing channels to double their previous lengths. An innovation has been the installation of a conveyor belt for the removal of the pulp from immediately behind the pulper to a trailer. The pulp is separated from the water which is then used to increase the flow in the pre-fermentation washing channel. If necessary this water could be pumped back for re-use in pulping.

The construction of the new drying-shed continued; eighteen trays were in use at the end of the year.

Experiments using (a) Gordon's "Guardiola"-type coffee drier, and (b) a Nu-Way grain drier adapted for coffee-drying were initiated but results are not yet available.

The preparation of a large number of out-turn and liquoring samples from station experiments was again undertaken. Further investigations were made into the possibilities of using the weight of wet parchment to obtain an out-turn figure.

Seed

The heavy demand for seed continues. Orders from the 1953/54 crop up to the end of the year amounted to 3,054 lb. and they are still coming in. Owing to the lateness of the season some 1,680 lb. only had been supplied by the end of December, 1953.

Pests and Diseases

White Stem Borer (*Anthores leuconotus*).—Towards the end of the year experiments at the lower end of the station were treated with Dieldrin. The method of application was by spraying the bottom eighteen inches of all stems with a hand fog-sprayer.

Antestia (*Antestia lineaticollis*).—DDT was incorporated in the two routine fungicidal (copper) sprays as a precaution. Test spraying later in the year revealed the necessity for additional applications of DDT on a few experiments.

Leaf-miner (*Leucoptera* spp.).—A very severe attack resulting in almost complete defoliation on some trees occurred towards the end of the year in Blocks 28 and 29 on Lyamungu Coffee Estate and to a lesser extent in some experiments.

Mites (*Hemitarsonemus latus*).—Some curling and distortion of the young leaves again occurred especially on unshaded coffee but no serious damage was caused.

Mealy bug (*Pseudococcus filamentosus*).—Incidence of this pest was fairly general in Experiment XV early in the year but declined later.

Green Scale (*Coccus africanus* and *Coccus viridis*).—Both Alboleum and Triona were used against green scale; the latter was the more effective.

Leaf Rust (*Hemileia vastatrix*).—This disease was fairly widespread throughout the station but was especially severe in the Clonal Selection Trials. Surveys in the Seedling Selection Garden and in the Clonal Selection Trials revealed that certain selections are more susceptible than others; the degrees of susceptibility will be studied in relation to yield. Some varieties of arabica in the variety collection also exhibited a considerable degree of resistance and some of these have already been used in the preliminary breeding programme mentioned earlier.

A fungicidal trial was laid down early in the year but unfortunately the incidence of disease in the particular area of the trial was only slight and no definite conclusions could be drawn.

A form of die-back was found on young trees in Experiment XVIIIA. Except for two other trees slightly affected this condition was confined to trees of the clone H. 61. The Plant Pathologist has isolated species of *Phomopsis* and *Colletotrichum* from the affected twigs but these may be secondary infections only. The matter is still under investigation.

Off-Station Experiments

No new off-station experiments were planted. Selection trials were recorded at four Moshi Native Coffee Board centres and on three estates.

Mbozi Sub-Station

Observations on the incidence of "black tip" and "die-back" were continued.

Approximately two and a half hundredweights of parchment coffee was produced from the station experiments.

Preparations were made for the planting of two new experiments. One is to compare the effects of mulches at two levels both with and without sulphate of ammonia; plots are split for multiple and single stem. The other is a pruning experiment having two single stem treatments and four methods of bringing young trees on to multiple stem.

A disastrous number of deaths occurred in Latin Squares III and IV of Experiment I (Seedling Selection trial) and unless these can be successfully supplied this next season the squares will have to be scrapped.

Chemist's Report

Complete soil analysis of the sixty-four plots of the irrigation and mulch experiment (XV) has shown that banana trash mulch both with and without irrigation treatments has, over thirteen years, significantly increased organic matter exchangeable calcium and potassium. These increases have been quite large, potassium being increased by about 100 per cent. There has also been an increase in half a pH unit in soil reaction and an increase in the percentage of waterstable aggregates of greater diameter than 0·5 mm. Analysis of another mulch experiment (XIVA) has also shown similar conditions to hold for organic matter and soil reaction under banana trash mulch but not under elephant grass mulch. Other experiments involving mulches are to be sampled and analysed in 1954.

Regular soil sampling and nitrate determinations under mulches applied before and after the rains have shown the initial advantage with regard to nitrate level to lie with mulch applied before the rains but that this advantage gradually decreases throughout the year. Further experiments are contemplated.

Gypsum soil-moisture measuring blocks have been calibrated with a view to installing them in the irrigation and mulch experiment.

Experiments on the artificial fermentation of coffee have shown that overnight fermentation can be economically achieved with commercial pectic enzymes but there has so far been a loss of quality in the coffee to the extent of one class.

Work was started on the vacuum-drying of papain; this is continuing. The problem of "pink papain" has also been studied and it is suggested that while oxidation may be responsible for discoloration on coagulation, papain that goes pink on storage is probably exhibiting another phenomenon.

Miscellaneous work done includes the analyses of soil samples from four estates, irrigation, silage and compost samples, and various moisture determinations for coffee drying experiments on the station.

Animal Husbandry

At the end of the year the Zebu herd consisted of ninety-three cows, heifers and heifer calves, forty-four bullocks and bull calves, and two bulls. The second bull, a three-quarter pure bred Guernsey, was purchased as a yearling in December with a view to grading up the herd and improving milk yields.

Nineteen bull calves and twenty-eight heifers were born and ten of the lowest yielding cows were culled. Nine bullocks were slaughtered to provide meat for station labour.

There was a marked absence of disease amongst the fully-grown stock. There were two cases of Anaplasmosis which recovered after treatment and one suspected case of "fly". Scouring and other stomach ailments accounted for several deaths amongst the bucket-fed calves but towards the end of the year a system of suckling was introduced whereby the dam was partially milked by hand and the calf finished the remainder. Calves suckled in this way were noticeably healthier than the bucket-fed calves and the cows appeared to produce more milk under this suckling system.

Throughout the year there was an abundance of grass for grazing and the hairless type of elephant grass was fed to the cattle at night. Approximately two hundred tons of good quality silage was made from maize chopped in a roughage mill and blown into pits.

Ecological conditions in this locality do not appear to suit the black headed Persian flock of sheep as their growth rate is poor and prolificacy below average. A Wiltshire horn ram was therefore purchased in an attempt to bring about an all-round improvement in the flock.

L. M. Fernie,
Acting Senior Research Officer

AN ACCOUNT OF THE WORK AT MARUKU COFFEE STATION, BUKOBA, FOR THE YEAR 1953

The functions of this station are to investigate means of extending the cultivation of robusta coffee into lands of low fertility which are not at present used for that purpose and which are situated outside the sheltered valleys where the crop is now grown. Many questions are involved and investigations are being directed towards providing shelter, to increasing fertility and to combining animal husbandry with coffee cultivation.

Two important problems are becoming more evident as results begin to accumulate and as these apply to most experiments they may be mentioned here.

The first is the apparent initial toxic effects of some fertilizers. These appear to be sulphate of ammonia and possibly muriate of potash. This would appear to be associated with the absence of clay or humus to hold the fertilizer and the very porous nature of the soil allowing rapid movement in the soil.

The other problem is the extreme patchiness of the soil. It frequently seems that the differences in fertility between patches in the same plot appear to be far greater than the treatment differences between plots. The fact that these patches are due to infertility has not been proved but there seems to be no other explanation. There is no sign of pests or diseases which could cause the effect. The patches are too small for it to be likely that water relations, underlying rock or some similar factor is the cause.

TRIALS AND EXPERIMENTS

Banana Establishment Trial

The difference in growth between plots receiving different treatments are far out-weighed by the limiting effect of the winds from the lake and the proximity of eucalyptus trees. The treatments were repeated in September; viz. coffee husk ash.

FYM, NP, FYM and NP, Sulphate of potash, Control.

The cuttings of "minyara" (*Euphorbia* sp.) which were planted last year to grow into a hedge have made practically no growth. Couch has again been cleaned from around it and a further strip cleaned and planted with other hedging plants. Compost will be applied as soon as possible since it is of vital importance to obtain a good wind-break without further delay.

This matter of the establishment of hedges merits further consideration and may perhaps best be made here. The important part played by hedges, the bananas, and the coffee in creating an ecoclimate within the fields considerably different from that experienced in the open grassland has been fully realised for a long time. The point that has, it seems, been missed by those who advocate hedge-planting is that the problem of establishing coffee and bananas also applies to establishing hedging plants. Establishment trials of hedging plants including differential treatments may well be necessary.

Bananas

Growth has been most disappointing this year particularly in the part planted first (in 1949) despite the annual dressing of compost. The reason for this is not clear and may be any one of the following:—

(i) The inter-planted kudzu vine has now produced a root system sufficiently large to compete with that of the banana. Although the kudzu does after many months root at the nodes to some extent the main root system remains that original tap root. Since the plants were put in the centre line between the rows of bananas the root system is as far as possible from the bananas. Alternatively it may be that the kudzu was allowed to grow too tall before being cut down. Patches are being completely cleared of kudzu to see if the bananas on such patches grow better. The rest is being cut frequently.

(ii) The usual dressing of compost, fourteen lb. per clump of bananas (thirty-three tons per acre) is insufficient. To test this a dressing of seventeen tons per acre was applied in February but there has been little response.

(iii) The effect of an invasion by banana weevils and the subsequent control measures adopted. Coffee seedlings (223) were inter-planted 18 ft. × 18 ft. during October. The seedlings were from Karagwe none being available in the eastern areas.

Coffee Progeny Trial

The Coffee Establishment Trial was a failure and in January the fertilized soil was dug out. In February it was decided to change the use of the area to a coffee progeny trial. Compost, fourteen lb. per hole, was mixed with the top-soil. The area was planted early in March. About fifteen per cent failed to establish and had to be re-planted within the first few weeks. However some thirty per cent are very yellow and are not flourishing. Further re-planting of six per cent took place in October.

Coffee Establishment Trial II (a)

In February it was decided to lay down a further trial to establish coffee with artificials and organics.

In March the seedlings were planted without treatments and only some two per cent died. In April the treatments which were the same as in the Coffee Establishment Trial were applied. They were as follows:—

N	NP	PK	KD	NPK	NPKD	(NPK fertilizer applied at ¾ lb. per tree of each fertilizer in treatment).
P	NK	PD		NPD	Control	
K	ND			NKD		
D				PKD		(D compost at 42 lb. per tree).

It was hoped that the delay in applying the fertilizers would obviate leaf fall and death of the seedlings which had occurred in many plants in previous plantings. In actual fact leaf fall and death occurred after application of the fertilizers. Nitrogen and to some extent potash seemed to be the cause.

By October some forty per cent of the seedlings had died and those surviving were not flourishing.

Coffee Establishment Trial II (b)

The aim of this was to try to establish coffee by methods which the Bahaya have available. The following were used:—

(i) decayed grass
(ii) coffee husk
(iii) chopped decayed fibre
(iv) manure
(v) grass burnt in hole
(vi) chopped decayed banana leaf
(vii) Ca (obtainable if not available)
(viii) chopped decayed banana skins
(ix) control
(x) burnt grass
(xi) control (no other material available).

The trial was planted in early March. Some fifty per cent of the seedlings had died by August and the rest were not flourishing.

Residual Fertilizer Experiment

The area where eleusine had been grown with fertilizers and compost in late 1951 and early 1952 was planted again in November to measure residual effects of the treatments. Germination was good but the crop died soon afterwards. A further sowing was made in early March this time of sorghum and seed germinated well. After a week the seedlings began to show a red colour in the leaves and to die off. Eventually all but a few individual plants died.

From this it seems that the effect of fertilizers and compost may be lost within a season on the shallow sandy soil typical of the grassland soils on which this experiment was laid down. (There are other parts of the farm where this certainly does not apply). Nevertheless by October there were some very marked differences in the grasses, etc., which have invaded the plots. Whether this is due to differential crop growth in the eleusine or to the differential treatments (or both) is being examined at the present time.

An observation trial to discover whether a more satisfactory cereal than eleusine could be used for manurial investigations was laid down, bullrush millet being the crop, with forty-one variations of N.P.K., Lime, F.Y.M. and ash. Other trials designed to throw light on the fertility status of this soil are being carried out with eleusine both in plots and in pots, one of them being to observe the effect of bringing up marl which underlies the surface sand.

The herd consists of ninety-eight mature animals with followers and they are used in pasture trials designed to find ways of increasing the grazing.

Pasture Observation Trial

This trial was laid down in January. The area was first mown to facilitate the distribution of fertilizers. Each plot is a quarter-acre.

Treatments are as follows:—

Plot:

1 Ca at 20 *tons* per acre
2 N at 106½ lb. P at 233 lb. K at 53¾ lb. all per acre.
3 FYM at 5 tons per acre
4 Control.

The plots were cut again beginning on 9th September. Earlier cutting would have been desirable as the material was over mature but was impossible due to other work and mower breakages. Procedure was to weigh green and again when dry.

Yields were as follows:—

Treatment	Yield per plot dry weight lb.	Yield per acre dry weight lb.
NPK	1,489 ...	5,956
Ca	1,119 ...	4,476
FYM	950 ...	3,800
Control	726 ...	2,904

Original Grass

The object of this is to retain some part of the farm in the condition of the natural grazings. It is to be burnt annually. An indication of productivity is being obtained by weighing the crop before burning.

Paddocks

The purpose of the trial begun in late 1950 is to find ways of improving the local pastures which would be within the scope of the people.

Treatments are as follows:—

(1) Paddock cut with mower then grazed "on and off" as "keep" offers. If grass gets away it is topped with mower.

(2) Paddock burnt then grazed as for (1).

(3) Paddock cropped with bambarras and then grazed as for (1) and (2).

Records are kept of hours grazed giving productivity in terms of cow hours or cow/days.

During 1953 there has been little change in these paddocks compared with 1952 although through undergrazing early in the year the *Eragrostis blepharaglumis* has spread on the bambarra paddock especially between the old ridges where cultivation was less.

On the grazed and mown paddock the carrying capacity has been found to approach a beast to the acre.

Grass Museum

There are now over fifty herbage species planted in the museum. It is intended shortly to have samples of material in various stages of growth and seasons analysed for nutritive value.

G. K. Reakes-Williams,
Agricultural Officer

AN ACCOUNT OF THE WORK AT MBOSI COFFEE SUB-STATION, SOUTHERN HIGHLANDS PROVINCE, FOR THE YEAR 1953

For the second consecutive year weather conditions were unfavourable for experimental work, rainfall being inadequate and poorly distributed. Establishment of three series of coffee experiments continued. These were:—(a) a large variety trial (b) an experiment to compare the yield of six seedling selections at four spacing distances with and without silico-phosphate treatment and (c) an experiment to investigate methods of establishing coffee with silico-phosphate, compost and nitrate of soda treatments.

Annual applications of two ounces of sulphate of ammonia in the latter experiment is having a marked result on the trees and in enabling them to withstand the dry season more effectively than the untreated trees.

Preparations have been completed for the planting of two further experiments which have the object of ascertaining how coffee reacts to mulch under local conditions and to compare yields resulting from the growing of coffee on the single and multiple stem systems.

The nursery for raising seedlings of new coffee selections and shade tree seedlings continued to be maintained and trials and multiplication of a large number of grasses were carried out. Observations continued in the greenhouse on the effect of temperature and shade on coffee in relation to the problems of "die back" and "black tip".

In addition to work on coffee the station served as a site for observations and trials on other crops which included wheat, niger oil, linseed, lespedeza and oats. It is expected that additional land will be acquired in 1954 for the expansion of the sub-station activities. A coffee factory is in the process of construction and an engine and pump have been installed at the site of a borehole.

SISAL RESEARCH STATION, MLINGANO, NGOMENI
ANNUAL REPORT FOR THE YEAR 1953

PART I

Staff—European

Officer in Charge	G. W. Lock, O.B.E., N.D.A., N.D.D., C.D.A., A.I.C.T.A., Senior Research Officer.
Plant Physiologist	E. C. Diekmahns, B.Sc. (Hons.), Dip. Agric. Sci. (Cantab.).
Soil Chemist	F. Leutenegger, Dr. sc.tc., ing.agr. E.T.H.
Scientific Assistant	J. F. Osborne, B.Sc. (arrived on first appointment 9th March, 1953).
Field Officers (Agriculture) ...	R. Simpson.
	J. W. Packard (left on vacation leave 5th July, 1953).
	D. M. Mowat, (arrived on first appointment 19th May, 1953).
Librarian and Secretary ...	Mrs. A. Scott-Elliot (resigned 15th June, 1953).
	Mrs. G. W. Lock, (temporary as from 19th June, 1953).

The posts of Entomologist and Geneticist remained vacant throughout the year.

The Scientific Assistant is employed on spectrographic analysis of soils and plant tissue. By kind arrangement with Sir Bernard Keen, D.Sc., F.R.S., Director, East African Agriculture and Forestry Research Organization, Muguga, Kenya, Mr. Osborne received three months' preliminary training under Mr. G. T. Chamberlain, Spectrochemist, East African Agriculture and Forestry Research Organization at Muguga shortly after his arrival in Tanganyika. He resumed his duties at Mlingano on 5th July, 1953.

Before her resignation Mrs. A. Scott-Elliot carried out part-time work in the library of the association at the Lead Memorial Building, Tanga.

During the year continuity in the research activities of the station was ensured since none of the scientific workers was absent on vacation leave.

Staff—African

For the greater part of the year the African staff remained largely unaltered but one laboratory assistant resigned and another was dismissed. One new assistant was appointed for work in the spectrographic laboratory and there are still vacancies for two others.

In the interests of economy, twenty-five posts as recorders, clerks, drivers, artisans, etc., were made redundant about the end of the year and the staff was reduced accordingly. The number of labourers employed was also reduced although all experienced long-standing employees have been retained.

One overseer and three assistants from the Department of Agriculture are posted to Mlingano for citrus propagation work.

Touring

The Senior Research Officer attended a Soil Fertility Conference held at the East African Agriculture and Forestry Research Organization's centre at Muguga in February and read a paper on sisal manurial trials. He was also present at the annual Field Day of the High Level Sisal Research Station, Thika, Kenya, in September. Three journeys were made to the Central Line, visiting estates and working on external trials, twice in company with the Soil Chemist. An estate near Tabora was visited by these two officers in December. The Senior Research Officer attended two meetings of the Tanganyika Sisal Board, one of which was held in Dar es Salaam, and made thirty visits to estates on the Tanga Line and eighteen visits to estates on the Central Line.

In addition to his journey to the Central Line the Soil Chemist travelled widely throughout the Tanga Province making advisory visits and collecting soil samples. The Plant Physiologist was requested by a few estates to examine special problems arising in plantation sisal.

Both field officers carried out routine visits to the external trials situated in the Tanga and Eastern Provinces in connection with cutting, recording or applying fertilizers.

Buildings

Apart from erecting a small annexe to the spectrographic laboratory for housing an air compressor and an electrode lathe no major building work was carried out during the year. Extra fume cupboards, benches and shelving were fitted in the soil chemistry and spectrograph laboratories as well as the dark room. Accommodation for the cattle was extended by joining up two sheds to form one large building. Two artisans are employed regularly on upkeep work. A large part of the labour camp was rethatched. One water storage tank which developed a fault was repaired satisfactorily.

Water-Supply

Owing to poor rains in 1952 the water in the dam was at a low level at the beginning of the year but it filled to fifteen ft. on 19th May and overflowed during the short rains on 19th October. The station has therefore had ample water supplies. The rain-water storage system for the laboratories proved to be adequate throughout the year.

Electricity and Gas

The installation of the spectrograph necessitated extensive additions to the electric wiring system including altering the supply from single phase to three phase in the spectrograph and soil chemistry laboratories. The gas plant functioned satisfactorily throughout the year.

Laboratory Equipment

All the former indents for major items of laboratory equipment placed through the Crown Agents for the Colonies were fulfilled during 1953 and latterly deliveries have been expeditious. The large arc spectrograph (for trace element determinations) arrived together with a flame photometer, drying ovens and other general equipment. A consignment of special glassware is expected shortly. The station is now very well equipped with modern apparatus and future indents will be confined mainly to consumable items such as chemicals and glassware.

Machinery and Equipment

No new agricultural machinery was purchased during the year. The field mower has proved most useful for the upkeep of land under grass. The tractor-mounted spraying machine was modified for use in bulbil nurseries. One pick-up and two old lorries were sold.

Library

The station already has a comprehensive range of text-books on agricultural and scientific subjects and only a few new volumes were purchased. Copies of fifty technical journals are received regularly and several thousand references were card-indexed according to the Universal Decimal System of Classification. The library is open to sisal growers for any information which they may require on specific matters of agricultural interest.

Clearing and Planting Work

Nearly seven hectares of land were cleared of secondary bush growth and remnants of Ceara rubber for planting maize during the main rains. This crop grew fairly well but it became heavily infected with the new form of maize rust (*Puccinia polysora*) when it reached the cobbing stage. A second sowing on the same land was made at the end of August but this was almost free of rust and the yield of grain has been reasonably good. Nearly one hectare was cleared and stumped for a bulbil nursery. Bush growth has been kept down in all the developed sections of the station.

Six new trials were planted this year including one external trial in the Kilosa District and three existing trials were replanted with sisal. All are making good progress.

Citrus

Nearly 7,000 citrus trees propagated in nurseries were lifted and dispatched to estates and other purchasers. Unfortunately heavy losses of budded trees were sustained through a collar rot caused by a fungus which was determined by the Plant Pathologist, Lyamungu, to be *Fusarium sclani*. It is now necessary to move the nurseries on to fresh land and seed beds of rough lemon stocks were put down near the dam. Seedling orange trees are also being raised, the seed having been collected from local high yielding trees selected by the Agricultural Officer, Tanga.

Bast Fibre Crops

The plots of ramie (*Boehmeria nivea* and *B. utilissima*) were given a heavy dressing of cattle manure and there was a response in growth during the main rains the stems attaining a height of approximately four feet. There was another flush of growth resulting from the short rains but the crop has suffered severely during recent dry and windy weather. A small plot of another type of ramie originating from Florida was also planted.

Seed of Kenaf (*Hibiscus cannabinus*) was sown in a multiplication plot but its growth was disappointing.

Cover Crops

Leguminous cover crops have seldom grown very well on the acid soils at Mlingano. Tropical kudzu vine (*Pueraria phaseoloides*) does not withstand drought which causes it to die back but scattered plants survive in competition with "Ukoka" grass (*Panicum trichlocladum*). *Centrasema plumierii* has made similar growth. The indigenous *Glycine javanica* does best of all.

Elephant Grass

Land previously under agaves or food crops continues to rest under elephant grass (*Pennisetum purpureum*). Five hectares were replanted and treated with nitrogenous and phosphatic fertilizers to provide fodder for the cattle. A part of this area was cut for silage.

Livestock

At the end of the year the herd of cattle kept on the station in fly-proof byres comprised seventeen milking stock inclusive of five Boran cattle, fourteen yearlings and eleven calves, totalling forty-two head of stock. Nine heifer calves and two bull calves were born of which nine were sired by the grade Ayrshire bull. Nineteen animals were slaughtered for meat. Two hundred and eighty-one gallons of milk were sold during the year.

Weather

The total rainfall during 1953 amounted to 50·6 inches which is above the average for the past nineteen years (46·7 inches).

At the beginning of the year strong north-easterly winds prevailed throughout January and continued into the first three weeks of February. Except for a few scattered and mostly light showers the weather was dry and hot. The station had a parched appearance such as is usual at this season of the year.

The drought was broken on 10th March when the winds veered to the south bringing showery weather which lasted until the end of March afterwards becoming more intensified during April and May. The heaviest precipitation in one day was 3·36 inches on 14th May otherwise the rains were excellently distributed over twenty-one days in April and twenty-five days in May. These conditions were almost ideal and favoured all crops but they ended very abruptly and June was practically a rainless month.

This proved to be a temporary setback since light rain fell in July and there were steady showers during August and also in September culminating in exceptionally heavy short rains in October. These tailed off during November and the weather was much drier throughout December.

While the total rainfall was not abnormally great the distribution was generally good since rain fell on 159 days.

Rainfall Records

Month	1953 *Inches*	1953 *No. of days*	average for 19 years *Inches*	average for 19 years *No. of days*
January	1·90	9	1·12	5
February	1·03	2	1·41	5
March	3·04	13	4·25	10
April	7·20	21	7·26	17
May	11·37	25	9·80	20
June	0·78	3	2·10	11
July	1·66	11	1·76	12
August	4·06	20	2·33	13
September	3·43	19	3·43	13
October	11·00	19	5·49	12
November	2·78	12	4·69	12
December	2·35	5	3·09	11
Total	50·60	159	46·73	141

Wind measurements were highest during January, February and December. The total number of hours of sunshine was slightly lower than the average, the sunniest months being February and December. The sunshine recorded in June was high for this month compared with other years.

Maximum and minimum temperatures tended to be lower and soil temperatures varied 7°C between the hottest and the coolest periods of the year.

Programme of Experimental Work

The present programme of field experiments comprises thirty-six trials, of which thirteen are sited on outside estates involving the recording of 2,135 plots. During 1953 six new trials were started at Mlingano and two were replanted including one external trial. The majority of these trials deals with problems concerned with the maintenance of soil fertility and only nine experiments are related to questions of plant management such as spacing, cutting, or spraying with insecticides.

As has been emphasized in previous reports the sisal plant is neither an annual nor a true perennial and this characteristic has an important bearing on the speed of obtaining results. Sisal has a vegetative phase lasting from four to ten years depending on environmental factors which means that the full effects of any treatments cannot be ascertained until this period of time has elapsed and an experiment has reached finality. As an example it may be mentioned that the reduction in fibre yields brought about by heavy cutting only became apparent this year or six years after this particular experiment was started.

Notwithstanding this handicap good progress is being made and new knowledge of value to the sisal grower is forthcoming every year. Certain of the data which is being accumulated on spacing and cutting methods confirms results obtained from earlier experiments and tends to show that the rules governing these aspects of sisal growing are of general application after making due allowance for soil and climatic conditions.

Bigger contrasts between the plots in all the manurial trials put down before 1953 can now be observed and these experiments are helping to throw more light on the nutritional requirements of sisal on various soil types. This work is augmented by soil and plant analyses and pot culture studies for reproducing diagnostic symptoms of various deficiency diseases. Current results from the factorial manurial trial are extremely interesting. The importance of calcium for sisal both for rectifying soil acidity and as a plant food is steadily emerging. Nitrogen is essential for healthy growth and it also accelerates the rate of leaf production. Sisal also needs phosphate which improves growth on some soils particularly during the early stages of the crop. Striking results have been obtained with potassic fertilizers on land deficient in potassium but this does not apply for the present at Mlingano. Sisal waste has been shown to be a valuable manure both in nurseries and in the field providing the dressings are adequate.

It is still too early to report on the value of grass leys or other resting crops between cycles of sisal for maintaining fibre yields. However young sisal growing after two or three years, fallow is distinctly promising especially when the fallow crop was treated with nitrogenous and phosphatic fertilizers.

A notable advance has been made in the entomological sphere. Spraying newly planted sisal with dieldrin has reduced losses of transplants through weevil damage to almost negligible proportions and the adoption of this plant protection measure in practice can be recommended.

Field Trials on the Station

An outline of the principal experiments in progress is given in the following review. Statistical data and full details are provided in Part II of this report.

Cultivation Trial. This experiment is now in its eighteenth year. It compares the effects of six degrees of weeding varying from clean weeding to no weeding. The clean weeded plots are now carrying third cycle sisal which is approaching the poling stage. This sisal is most unthrifty and is suffering from numerous deficiency diseases. The yield of fibre to date (5·92 tons per hectare) is much lower than that for the second cycle (11·7 tons per hectare) and less than half of that obtained on virgin land during the first cycle (14·4 tons per hectare). Clean weeding has led to deterioration of soil structure and loss of fertility.

Sisal weeded at intervals or interplanted with a cover crop did not grow so rapidly as that kept free of weeds, particularly when it was young, during the second cycle. Similar effects were noted as in the first cycle. Fibre yields declined in the second cycle despite a partial or complete cover on the soil and some of the plots have severe symptoms of banding disease. Second cycle sisal growing in competition with uncontrolled weeds and bush, although healthy, has yielded very little crop to date.

Third cycle sisal which has received periodical weeding is not very good and yields have been light.

The results of this experiment point to the necessity of weeding young sisal whatever the fertility status of the soil may be for rapid initial growth and for the recovery of a high proportion of the potential number of leaves for crop. On the other hand the dangers of clean weeding are stressed and it is imperative to maintain a cover on the soil. This by itself however is insufficient to arrest a decline in yields under a system of continuous cropping with sisal.

Spacing Trial.—The Spacing Trial also dates back to 1936 and is being continued in order to study the effect of different plant populations on the rate of soil impoverishment. There are eight treatments ranging from 1,666 to 10,000 plants per hectare. First cycle results are complete and they show a high positive correlation between plant population and fibre yields. A similar trend can be observed in the total yields for the second cycle up to 5,000 plants per hectare but the visible signs of decline of the sisal such as can be noted in the field are not shown up in the yield data yet owing to better cutting methods having been used during the second cycle. Third cycle sisal planted at low densities between 2,500 plants per hectare has given lower yields. The plants suffered from deficiency diseases while the need to clear and replant at frequent intervals on account of the short life-cycle of the sisal has had a deleterious effect upon soil fertility. It would appear from results of two cycles of this experiment that fibre yields are reduced when the density of plants is less than 4,000 per hectare.

Spacing × Cutting Trials. One of the spacing × cutting trials has been repeated for a second cycle and the sisal is now four and a half years old. As poling has not been extensive it is still too soon to see the effects of the three levels of plant population, 4,000, 5,000 and 6,000 plants per hectare on total fibre yields. So far plots cut early at two years from planting have yielded slightly better than those cut later at two and half or three years. Distances between the rows of sisal, or whether single rows or double rows, and cutting cycles have had no effect upon current yields. The results of the first cycle were similar but it is expected that the yields of the second cycle will show a substantial decline owing to the condition of the sisal. Over a large part of the trial area the soil has become markedly acid and the plants have symptoms of chlorotic mottling, purple leaf tip roll, and nitrogen deficiency. Bole rot has also been common.

The Severity of Cutting Trial incorporates plant population together with various cutting treatments. The sisal is now six years old and heavy poling has occurred in the 4,000/hectare and 5,000/hectare plots. Total fibre yields tend to rise with plant population but at present commencing to cut at one and a half, two, or two and a half years has not affected yields to any extent. The same applies to cutting cycles of six, nine and twelve months. In the three severity of cutting treatments, eight, sixteen and twenty-four leaves were left per plant respectively whenever cutting took place, and heavy cutting has reduced yields by two and a half tons per hectare to date, or over fifteen per cent. The leaves of the heavily cut plants were lighter and contained less fibre than those from plants cut more reasonably.

In the Early Cutting Trial started on virgin land in 1951 cutting began at nine, fifteen and twenty-one months from planting and was continued on cycles of six, nine and twelve months. Heavy, normal and light cutting is also practised and in addition there are three levels of plant population as before. Many of the combinations of these cutting treatments constitute drastic or fairly drastic measures and consequently most of the sisal in this trial tends to be dwarfed for its age. Young sisal cut early, frequently and heavily is very short and is giving leaf of No. 2 quality only. Up to the present the cutting treatments have had no effect upon the unfurling rate of new leaves. Although this experiment has several years to run before final results will be known already it is very evident that young sisal should never be cut heavily.

Fertility Trial.—This is a long-term rotational experiment for testing the value of certain resting crops including a tumble-down fallow each lasting for two or three years between cycles of sisal for maintaining soil fertility. Three of the twelve treatments represent sisal planted immediately after sisal without any resting period. This sisal is nearly four years old and has been cut twice. Yields have tended to be variable and it is too soon to compare them with those obtained during the first cycle on virgin land.

Seven of the fallowing treatments were replanted in late 1952 and the other two in April, 1953. The young sisal is making excellent growth more especially after elephant grass or a green manure treated with nitrogenous and phosphatic fertilizers or two years of *Tephrosia candida*. The differences between the plots however are not very great at this stage of the trial.

Grass Rotational and Manurial Trial.—Up to 1951 the land in this experiment had carried sisal continuously for fifteen years and the soil had become impoverished. The experiment aims at restoring fertility through the agency of grasses and with the aid of fertilizers. Plots were put under sisal again, guinea grass and elephant grass for two years and then ploughed and replanted in 1953. Lime, nitrogen, phosphate and potash, each at two levels, were applied to the grass leys. Half the grass plots were grazed and the other half cutlassed periodically.

The sisal is still young but the best growth appears to be taking place on plots after elephant grass which was manured with lime, nitrogen and phosphate.

Factorial Manurial Trial.—This complex experiment has now been in progress for four and a half years. The treatments comprise dressings of ground limestone, nitrogen, phosphate and potash in every combination and each applied at three rates, viz. none, moderate and heavy dressings, all but the lime having been applied annually.

In order to avoid cutting effects each plot is cut separately according to its rate of leaf production. All the plots have now been cut twice and the combined yields for the first and second cuttings show significant responses to lime and phosphate and a smaller response to nitrogen, potash having no effect. Nitrogen however has accelerated the unfurling of new leaves to such an extent that these plots have been cut three or four times to date. The average yields of plots cut twice only is 1·9 tons per hectare, those cut three times have yielded about 4·75 tons per hectare, while the most advanced plots which have been cut four times have yielded 9·06 tons per hectare. Over the first and second cuttings only, the response to the double dressing of lime is 0·8 tons per hectare compared with 0·4 tons per hectare for the double rate of phosphate. Some of the most forward sisal has begun to pole but it appears likely the total yield of fibre will be comparable to that obtained on virgin land.

Fertilizer Placement Trial.—The fertilizer treatments in this trial are restricted to nitrogen and phosphate, each of which have been applied in three ways (i) on the rows of sisal, (ii) on the grass cover strips between the double rows of sisal, and (iii) broadcast. First cutting results show a highly significant response to nitrogen but that due to phosphate is not significant. The different methods of placement have made no difference in the case of nitrogen and of course, cannot be determined for phosphate since this response is not significant. Growth records however illustrate how nitrogen accelerates growth and points to the fertilizers acting best if they are both placed on the rows of sisal.

Mulching Trial.—Various organic mulches and manures including sisal waste were applied annually along the rows of sisal during the first three years of this trial. One treatment comprises inorganic fertilizers only. The sisal is now four and a half years old and up to the present it has been cut three times. Current fibre yields are disappointing but the trial is sited on old land. Unfortunately soil variation has masked treatment effects to a large extent and has also resulted in a high experimental error. Nevertheless the yield data suggest that old sisal waste applied at the rate of 50 tons per hectare each year has been most beneficial, followed fairly closely by inorganic fertilizers. Coconut cake resulted in slightly higher yields than either cotton seed or elephant grass while these two treatments themselves were not much better than the control plots or those which were not mulched. At this stage it would appear that the manurial value of a mulch is as important as its physical effect upon the conservation of soil moisture and preservation of topsoil structure.

Ridging Trial.—In this trial double-row sisal planted on broad-based ridges is being compared with that planted on the flat. The sisal is planted at a density of 6,000 plants per hectare and it is now rising to six years old. Heavy poling occurred during the latter half of 1953 especially in the ridged plots where 53 per cent of the plants have poled compared with 30 per cent for flat planting. This was not unexpected because the ridged sisal grew faster during the first two years. The sisal has been cut five times to date and current fibre yields are 15·1 tons per hectare for ridged sisal and 12·2 tons per hectare for sisal planted on the flat but the full effects of ridging will not be ascertainable until the trial has ended. Light dressings of fertilizers after each cutting have not affected fibre yields.

Interplanting Trial.—During the first two years after planting, maize, sorghum and beans were intercropped between double and single rows of sisal in this experiment, half of the plots receiving fertilizers. The sisal is now four and a half years old and it has been cut three times. As was noted in previous years, sisal intercropped with sorghum continues to be the most backward and aggregate fibre yields to date are significantly lower than those for the remaining treatments. Maize and beans have had no effect upon fibre yields; similarly neither single or double row spacing nor the fertilizers applied to the foodcrops have made any difference to the yields.

Permanent Bulbil Nursery Manurial Trial.—This experiment was repeated for the fourth year in succession on the same site. At the end of one year the plants were lifted and weighed and the results confirmed those obtained in former years. Wide spacing (50 × 25 cms.) was generally better than narrow spacing (30 × 25 cms.) but applications of fifty tons per hectare of old or fresh sisal waste brought about spectacular differences in growth. Plots given either old waste or fresh waste produced plants three times larger than those in the control. Plots receiving both old and fresh sisal waste grew plants more than seven times heavier than the control. Nitrogenous and phosphatic fertilizers had no effect upon plant size but sulphate of ammonia was conducive to severe chlorotic mottling of the leaves. It is clear that estates would be well advised to establish permanent bulbil nurseries near the factory where the land could be manured with sisal waste regularly and with the minimum of expenditure.

Bulbil Nursery Manurial Trial.—A new nursery trial was started in collaboration with the soil chemist to test the value of sisal waste, grass, and bitumenized paper as mulches coupled with deep and shallow cultivation, liming and no liming, and with and without N and P fertilizers (nitrate of soda and double superphosphate). A heavy application of nitrate of soda caused severe scorching of the leaves and this necessitated replanting the trial. Analysis of the scorched plants revealed that sisal takes up nitrate-nitrogen rapidly. The second planting was favoured by good rains and is growing satisfactorily. The plants are not due for lifting and weighing until next year but so far the differences between the plots are not large, growth possibly being best under a sisal waste or paper mulch.

Sisal Waste Manurial Trial.—The purpose of this experiment is to evaluate the use of sisal waste as a manure on land which has already carried sisal for many years. The dressings of waste were applied about three months prior to planting and the rate of application per hectare is related to the quantity of waste obtainable from 400 tons of leaf. This is roughly equivalent to the amount of leaf removed from one hectare during the previous cycle of sisal. The waste was applied in three forms (i) the total waste effluent as collected from a decorticator,

(ii) the solid portion only, and (iii) the liquid portion only. Another treatment comprised 50 tons per hectare of solid waste put down as a mulch along the rows supplemented with nitrogenous and phosphatic fertilizers.

The sisal is now twenty months old and is growing very well in plots given either total waste or the solid waste. Liquid waste or a waste mulch plus inorganic fertilizers have not had much effect upon rate of growth.

Nitrogen Fertilizers Trial.— As it has been ascertained that large dressings of sulphate of ammonia to sisal give rise to increasing soil acidity on certain soils which in turn accentuates chlorotic mottling of sisal leaves and also that sisal needs nitrogen for satisfactory growth a new trial was put down in April, 1953 to compare other types of nitrogenous fertilizers. In this experiment nitrate of soda, calcium nitrate and potassium nitrate as well as sulphate of ammonia, are being tried each at three levels, none, 50 and 100 kgs. nitrogen per hectare, and each with and without phosphate. The trial is sited on partially exhausted land.

The phosphate was placed in the planting holes before planting while the nitrogen was applied in a single dressing towards the end of the main rains once the plants had become established. On the whole the young sisal has made good progress and some plots are more vigorous than others. Incipient symptoms of banding disease have appeared recently in two plots which received nitrogen at the highest rate. Analysis of the latest growth records however shows no significant differences between any of the treatments and it is inferred that most of the nitrogenous fertilizer may have been leached out of the soil during the wet weather this year. In order to overcome this difficulty it is proposed to apply the fertilizer in smaller quantities on three occasions next year.

Lime Placement Trial.—Water culture work carried out by the plant physiologist indicated that calcium had a marked effect on the formation of new roots by bulbil plants. This observation was followed up in practice by putting down a new trial wherein ground limestone was placed in bands coinciding with the rows before planting. Nitrogenous and phosphatic fertilizers were used in addition. To date no differences in growth can be reported.

Soil Acidity Trial.—The exact causes of chlorotic mottling of sisal leaves are not yet known but this deficiency symptom is usually indicative of an acid soil or possibly a shortage of calcium. With the intention of elucidating this problem another new experiment was put down on land formerly under sisal which incorporated dressings of ground limestone and gypsum respectively with or without nitrogen and phosphate. If chlorotic mottling is directly attributable to a lack of calcium then both the ground limestone and the gypsum should lead to some improvement. If on the other hand it is associated with acid soil conditions the limestone treatment only should be effective because gypsum while supplying calcium does not alter the soil pH.

The sisal is still young having grown on the average about ten new leaves per plant since planting and it is too early to detect any differences in growth rates or to see any marked changes in the field.

Spraying Trial.—A simple experiment of large replicated plots planted either with bulbils or suckers (originating from an old field) was planted in June. Half of the plots of each treatment were sprayed immediately after planting with dieldrin applied at the rate of 1·2 lb. active dieldrin per hectare in ninety gallons of

water. The trial area has since been subject to a natural infestation of the sisal weevil (*Scyphophorus acupunctatus*, Gyll.) and the plots were arranged so that the treated ones conferred as little protection as possible on untreated plots. Spraying has resulted in greatly reduced losses of transplants due to damage to the bases of plants by larvæ of the weevil. In the case of bulbil nursery transplants losses have been reduced from 16·7 to 2·5 per cent while similar figures for the suckers are 11·0 and 1·1 per cent. These are not the final results since weevil breeding continues to take place inside infected plants within the experiment and higher losses are expected in the future. All the new trials planted by the station this year were sprayed and losses of transplants were only 0·5 per cent.

Agave Hybrids Comparative Trials.—Two experiments for testing selected hybrids of *A. angustifolia* and *A. amaniensis*, several of which were raised at Amani have been in progress since 1949 and 1950. Although many of these selections produce many more leaves than sisal their leaves tend to be short and light. Some have not grown as well as the original mother plants at Amani and show a proclivity for early poling.

External Trials

Spacing × Cutting Trial—Central Line.—One spacing × cutting trial started in the Morogoro District in 1944 is still in existence and it is not expected to pole out until the end of 1954. Growth has been slow and current yields are not above average. Many more leaves have been reaped per hectare from the high density (6,000/hectare) plots than the low density treatment (4,000/hectare) nevertheless there is no difference in fibre yields at present owing to the poorer quality of the leaf. This is largely due to bad soil management and excessive clean weeding when the sisal was young.

The other spacing × cutting trial in the Kilosa District ended last year and the final results were published in the 1952 report. This experiment has been replaced by one comparing three different methods of land preparation in combination with mulching and N and P fertilizer treatments. Soil samples were taken from each of the eighty-one plots in this area by the soil chemist and his analytical data suggests that the soil still has considerable reserves of fertility. The new sisal was checked by drought but it is now growing excellently. In the beginning sisal waste mulch resulted in a better colour of the leaves.

Grass Rotational × Manurial Trial—Tanga Coast.—This experiment is sited on a rather poor and acidic sandy soil in the coastal belt. Blocks were rested under elephant grass and guinea grass for two years, ground limestone, nitrogen and phosphate being applied to the grasses, while sisal growing was continued on the others and given the same fertilizers. The whole area was ploughed and replanted with sisal in September, 1952. The trial was also sprayed against the sisal weevil with highly successful results.

The young sisal has grown best on plots formerly rested under grass and which were limed and given nitrogen and phosphate, and altogether this sisal is reasonably promising. Sulphate of ammonia applied in the absence of lime has resulted in severe chlorotic mottling.

Grass Rotational × Manurial Trial—Korogwe District.—The design of this trial is very similar to that just described. The grasses have not made very vigorous growth and responses to fertilizers were not pronounced. The entire experiment will be replanted with sisal next year.

Banding Disease Manurial Trial—Tanga District.—Reference has already been made to the current results of this experiment. A fifth cutting was taken in September and heavy yields were obtained from the potash treated plots where the sisal continues to be healthy and free of banding disease. Current fibre yields are 16·60 tons per hectare for potash manured plots compared with 10·25 tons for those not receiving potash. This represents a response of 6·35 tons per hectare or 62 per cent, to 1,100 lb. of sulphate of potash applied at intervals during the first five years of the sisal. The cost is calculated to amount to Shs. 53/23 per ton of extra crop and Shs. 20/36 per ton of total crop. Nearly 50 per cent of the plants have poled in both the healthy and unhealthy plots and a final cutting will be made next year.

External Exploratory Manurial Trials.—Seven exploratory manurial trials have been in progress for the past two or three years in various parts of the Tanga Province and also on the Central Line. The manures under test comprise nitrogen, phosphate, potash, calcium and sisal waste. Each trial is sited on a main soil type which is representative of the district.

Only one experiment has been cut to date and in this case there was a response to nitrogen. In another where the soil is known to be low in potassium potash has had a dominating effect but calcium and sisal waste have also been beneficial. The latter is particularly evident in a trial on bulldozed land near Korogwe even though the plants were badly damaged by wild pigs. One trial on a red earth derived from coral has not yet shown marked responses to the manures although the sisal has grown satisfactorily. Generally speaking sisal waste has improved growth in most of these trials. A trial in the Morogoro District and another to test various levels of potash in a banding disease area have been checked by drought.

Plant Physiology

The use of the tissue test technique for the rapid analysis of dried sisal leaf was continued. The factorial manurial trial, permanent bulbil nursery manurial trial, fertilizer placement trial and the sisal waste manurial trial were all sampled for the purpose of investigating the uptake of nutrients from applied fertilizers. This series of leaf samples involved almost 550 analyses each in respect of nitrogen phosphorus, potassium and calcium. Several of these analyses were done in the spectrographic laboratory.

Further progress was made in sand and water culture studies for the elucidation of the problems of unbalanced nutrition in the sisal plant. In addition the effects of the acidity of the growing medium on the root growth of sisal bulbils were investigated.

Leaf Analysis.—The results of the analysis of leaf samples from various manurial trials can be summarized as follows:—

(1) The uptake of nitrogen, phosphorus, potassium and calcium reflects the application of the respective fertilizers.

(2) The uptake by the plant of phosphorus, and to a lesser extent nitrogen and calcium, from sisal waste greatly exceeds that from the appropriate inorganic fertilizers.

(3) Nitrogen as sulphate of ammonia restricts considerably the uptake of phosphorus and to a lesser degree calcium.

(4) Sulphate of ammonia is conducive to the development of chlorotic mottle in sisal leaves. This leaf symptom is always associated with low calcium content in the leaf.

(5) In all the samples examined chlorotic mottle was invariably coupled with a very high content of manganese.

Water Culture.—Sisal bulbils growing in water culture produced leaf deficiency symptoms resulting from the lack of specific nutrients as follows:—

No nitrogen—Pale yellow leaves, little or no growth.

No phosphorus—Purple leaf tip roll and poor rooting, followed by tip wither.

No potassium—Areas of necrotic tissue typical of banding disease.

No calcium—Plants failed to root and death ensued.

No magnesium—Brown necrotic lesions on the leaf blade.

In addition it was found that the acidity of the culture solution had an important bearing on the rooting of sisal bulbils and that the development of roots was markedly depressed with increasing acidity.

Sand Culture.—Leaf symptoms comparable to those obtained in the water culture experiments resulted from omitting the same elements from the nutrient solutions when plants were grown in pure sand.

Investigations into the toxic effects of certain of the heavy metal micronutrients—iron, manganese, copper cobalt and molybdenum—have shown that excess cobalt produces a severe chlorotic mottle of the leaves with both an acid (pH 4) and a neutral (pH 7) culture solution.

A replicated pot experiment investigating the effects of nitrogen, phosphorus, potassium and calcium at different levels has shown the greatest response to nitrogen. Ten times more dry matter was formed in plants receiving nitrogen than in those not given any nitrogen. The ratios for phosphorus, calcium and potassium were three, two and one and a half respectively. It is apparent that sisal requires all these four major plant nutrients correctly balanced for satisfactory growth.

Soil Chemistry

(*F. Leutenegger*)

During the year more than one month was spent in the field collecting another hundred soil samples and making advisory visits to twenty estates. The remaining time was largely spent in the laboratory completing the analysis of samples collected in 1952 with regard to phosphorus, texture, humus content, and calcium carbonate, total carbon and ammonia determinations. The analytical results of these samples in addition to those collected more recently are nearly finished and reports are being sent to estates as soon as all the data is ready. Some samples of limestone, water, ash and fibre which were sent to the station for examination were also analysed.

The bulk of the soil samples collected in previous years originate from widely scattered estates and cover a variety of soils and different climatic conditions. They form the basis of a preliminary survey for studying the properties and fertility status of the principal soil types used for sisal cultivation. Latterly the majority of the samples collected have been by the special request of certain estates which were confronted with specific soil problems in some of their areas.

These were analysed immediately and the findings reported to the estates. Now that all the necessary laboratory equipment has been received and the spectrograph has been installed it is possible to carry out such advisory work more expeditiously.

In the beginning the entire soil profile was sampled at different horizons but once it was established that the root system of sisal is mainly confined to the upper twenty centimetres of the soil, and furthermore that there is usually a sharp decline in fertility below this depth it was decided to take most of the samples from the topsoil only. This modification of sampling methods has meant that more topsoil samples could be examined which is desirable because not only do these soils show considerable variations but a high proportion of the samples received for analysis are concerned with advisory work. Pedological studies have had to be deferred for the present.

After all the reports on samples from estates have been dispatched samples collected from trial plots will be given further attention. Many of these samples have been analysed already although some spectrographic work and ammonia determinations still remain to be done. It is hoped to have this data ready before the trials are finished so as to afford a comparison between fibre yields and the fertility status of the soil especially as it may be influenced by manuring.

A field experiment was started at Mlingano last August for the purpose of investigating seasonal changes in the ammonia, nitrate-nitrogen, total nitrogen and phosphorus contents of the soil. The treatments comprise three levels of mulching, (i) bare soil, (ii) grass mulch, and (iii) paper mulch, in all possible combinations with no fertilizer, sulphate of ammonia, and ground limestone. Each of the thirty-six plots is sampled monthly and the duration of the trial will be one year so as to span two rainy and two dry periods. The object of the trial is to determine the best time when nitrogen might be applied and how long the fertilizer will persist in the soil and also to study the reactions of the two fertilizers on nitrate production, soil acidity (pH) and the availability of phosphorus. The complete results will not be known until August, 1954.

Experience has shown that analytical data for the total nitrogen in a soil does not always give enough information about the supply of available nitrogen. The ratio of organic carbon to total nitrogen which is commonly used for a better appraisal of a soil can also be very misleading in tropical soils owing to accumulations of ash and charcoal resulting from burning vegetation. Determinations of the amount of ammonia in the mulching trial mentioned above however showed unexpectedly high quantities of ammonia and it is therefore proposed to extend this kind of analysis to samples received from estates. Soils low in potassium as well as samples from banding disease areas will be analysed for ammonia with a view to elucidating the appearance of banding disease.

Nearly 300 soil samples have been analysed spectrographically including all those obtained from fields where the sisal is suffering from deficiency diseases.

Banding disease is the commonest deficiency disease of sisal and it is well known that it is attributable to an inadequate supply of potassium in the soil. It is also known that the symptoms of this disease may become worse after manuring with sulphate of ammonia. This could be due to upsetting the balance between nitrogen and potassium either directly through adding more nitrogen or possibly because the potassium in the soil is replaced by ammonia and subsequently is lost by leaching.

Armstrong Black in his *Report on a Preliminary Survey of Sisal Diseases in Tanganyika* (East African Agriculture and Forestry Research Organization, Amani, 1948) tentatively suggested that the soil K/N × 100 ratio might provide a critical figure especially for similar soils when banding disease was liable to occur. Analytical data obtained so far tends to confirm that there may be a critical ratio and that this may vary with the soil type and at different seasons.

The ratio may also depend upon the form of the nitrogen in a soil. It is generally accepted that the quantity of available nitrogen rises with increasing amounts of total nitrogen in the soil. The rate of nitrification however depends to a large extent upon soil acidity and soil aeration as well as upon moisture content which is influenced by climatic conditions. In addition ammonia and potassium can both become fixed in the soil and rendered less available depending upon the nature of the clay in the soil. These factors will all have some bearing on the K/N ratio and much more investigational work is required before definite limits can be established for different soil types. The grey and black soils are likely to present most difficulties owing to their greatly varying soil acidity, texture and structure.

Spectrographic Chemistry

(*J. F. Osborne*)

The scientific assistant spent a few weeks familiarizing himself with the work in progress at Mlingano before being posted to the East African Agriculture and Forestry Research Organization, near Nairobi, for training in spectrographic analysis. By the kind permission of Sir Bernard Keen, F.R.S., Director, this training in the use of the medium spectrograph was given by Mr. G. T. Chamberlain, Spectrochemist, over a period of twelve weeks in the course of which time a considerable number of soil and sisal samples from Mlingano were analysed.

During the commissioning of our medium spectrograph in July further valuable assistance was given by Mr. Chamberlain who paid a ten days' visit to the station. Since then analyses of accetate extractable bases in 240 soil samples from estates and of bases in ashes of 255 plants samples from station trials have been made the results of which are reported by the soil chemist and plant physiologist. This work comprised a grand total of 4,043 element determinations using the medium spectrograph. In addition 500 determinations of exchangeable hydrogen in soil samples were made.

An African assistant has been trained to extract the acetate soluble bases from soil samples and to prepare the solution for spectrographic analyses.

The flame photometer arrived in July but owing to faulty components it has not been possible to begin routine determinations of water soluble potassium and calcium.

Fibre Studies

Fibre testing work was stopped at the end of the year because it was not found possible to establish any relationship between fibre fineness and manurial treatments. Fibre from plants in the fibre characteristics trial which were cut heavily from an early stage onwards yielded fibre which was finer than that obtained from plants cut more reasonably.

Plant Breeding

Plant breeding work was confined to crossing F_2 *A. amaniensis* × *A. angustifolia* hybrids which poled during the year. The seed was sown in beds and the seedlings are nearly ready for transplanting to a nursery. The station continues

to safeguard a number of hybrids now growing at Amani which were originally raised by the Geneticist, East African Agriculture and Forestry Research Organization. Many are high leaf producers and have desirable leaf characters and in due course they will be valuable parent material for future cross pollination work.

Planters' Day

The annual Planters' Day was scheduled to be held in October but it was found necessary to postpone this function until 19th November owing to heavy rains dislocating communications. There was an excellent attendance of 200 visitors who were shown round the field trials and laboratories. A large party of African employees from sisal estates visited the station on the next day.

Publications and Reports

As in previous years, half-yearly progress reports were submitted to the Research and Mlingano Management Committee which were later circulated to all sisal growers by the Tanganyika Sisal Growers' Association. A review of recent progress in sisal research was also prepared by the senior research officer for the information of the Research Committee. A synopsis of paper by G. W. Lock, on "Sisal Manurial Trials" was published in the *East African Agricultural Journal*, Vol. XIX, No. 1, July 1953.

Malaria Control

The Malaria Research Unit, Amani, continued to assist the station in the application of malaria control measures.

Department of Agriculture and East African Agriculture and Forestry Research Organization

Four Senior Service and six Junior Service officers were seconded by the Department of Agriculture to the station as in the past.

Sir Bernard Keen, F.R.S., Director, East African Agriculture and Forestry Research Organization, who is also a member of the Research Committee, visited the station on a number of occasions and gave helpful advice on technical matters. Members of his staff have also assisted the station in various ways. Dr. H. C. Pereira, Soil Physicist, and Mr. G. T. Chamberlain, Spectrochemist, helping directly in connection with soil moisture studies and establishing the spectrographic laboratory.

The station co-operated with the Department of Agriculture in carrying out a maize manurial trial. The East African Agriculture and Forestry Research Organization continues to use a plot of land at Mlingano for testing cassava hybrids against mosaic and brown streak diseases.

Contact was maintained with the Government Chemist, Dar es Salaam, particularly in relation to soil studies.

Acknowledgments

Messrs. Noorani Plantations, Ltd. continued to assist the station by providing decortication facilities at their Ngomeni Estate and their invaluable assistance is gratefully acknowledged. Thanks are also due to Messrs. Amboni Estates, Ltd., Messrs. Bird & Co. (Africa) Ltd., Messrs. Central Line Sisal Estates, Ltd., Messrs. Consolidated Sisal Estates of East Africa, Ltd., Messrs. Tungi, Ltd., and other estates for their co-operation and help on numerous occasions.

G. W. Lock,
Senior Research Officer

ANNUAL REPORT OF THE ENTOMOLOGIST, MOROGORO FOR THE YEAR 1953

INVESTIGATION AND DEVELOPMENT

Stalkborers of Maize and Sorghum

Biological and ecological observations were made on the Anthomyid, *Atherigona indica*, Mall. and the Pyralids, *Proceras argyrolepida*, Hmpsn. and *Chilo zonellus*, Swinh. attacking short-term sorghums grown under irrigation at Morogoro in the dry season.

Atherigona, which is responsible for dead-hearts and subsequent production of tillers was found to attack the plants from about one week after germination onwards to heading. Egg counts made at two-day intervals indicated that three generations were obtained in the field, the time occupied by each generation approximately twenty days from egg to adult agreeing very closely with data obtained from parallel breeding work carried out in the laboratory.

Insecticidal dust treatments, four weekly applications at the rate of ten oz. per 1,000 plant hills and commencing eighteen days after planting were carried out against *Atherigona* in a small field trial replicated six times. Experimental results are given in Table I.

TABLE I. SORGHUM DEAD-HEARTS CAUSED BY *ATHERIGONA INDICA*, MALL. (*SORGHUM VARIETY—TADA*)

Number of Damaged Plant Hills

Days after planting:	*Treatments*				
	2·5% DDT plus 1·5% gamma B.H.C.	2·5% DDT plus 5% Toxaphene	2·5%DDT plus 2·5% Aldrin	2·5%D.D.T	Control
21	24	42	26	79	51
23	29	66	27	122	117
28	39	88	73	106	182
30	79	152	112	195	275
35	151	197	160	298	274
37	131	191	163	359	396
42	155	170	196	340	469
44	125	170	275	336	409

Total plant hills per treatment—864

Some falling off in numbers occurs towards the end of the records due to the fact that withered hearts are readily blown away by wind and the former damage therefore overlooked when counts are made. The highest figure recorded for the control, 469 damaged plant hills, representing 54·3 per cent of the plant hills in the treatment, had surprisingly little effect on the evenness of growth of the plants which headed at the same time as those in the best treatment (2·5 per cent DDT plus 1·5 per cent gamma BHC). Although yield figures were not available at the time of writing it appears that *Atherigona* is less of a pest than had been formerly thought even in out-of-normal season plantings

Attack by the Lepidopterous borers, *Proceras argyrolepida* Hmpsn. and *Chilo zonellus* Swinh. begins later than that of *Atherigona*, fourteen to twenty days after germination as opposed to approximately five days but is evidently more serious as is shown by the following experiment. Two blocks of short-term sorghums, varieties Early Shallu and Tada, were divided into two equal halves and dusted five times at weekly intervals with a 2·5 per cent DDT plus five per cent Toxaphene dust commencing twenty days after germination; the results are given in Tables II and III.

TABLE II. SHORT-TERM SORGHUMS DUSTED 5 TIMES WITH 2·5% DDT PLUS 5% TOXAPHENE

PERCENTAGE HILLS DAMAGED BY STALKBORER

Days after planting:	*Variety Early Shallu*		*Variety Tada*	
	Control	Treatment	Control	Treatment
34	12·4	0·2	18·9	0·9
41	24·8	0·4	29·0	1·2
47	32·0	0·6	30·2	1·3

TABLE III. SHORT-TERM SORGHUMS DUSTED 5 TIMES WITH 2·5% DDT PLUS 5% TOXAPHENE

NUMBER OF HEADED PLANTS

Days after planting:	*Variety Early Shallu*		*Variety Tada*	
	Control	Treatment	Control	Treatment
60	415	1,468	Not ready.	
75	Not recorded		385	1,079

Counts made before dusting began showed both the plant stand and the *Atherigona* infestation to be reasonably uniform in treated and control plots. Taken in conjunction with the former replicated experiment in which a control of *Atherigona* was obtained but in which nevertheless the growth of treated and control plots was comparable the greater importance of the Lepidopterous borers is apparent. Furthermore in the unreplicated experiment *Atherigona* attack had been allowed to proceed fourteen days or more before insecticide treatments were begun. Yield figures were not available at the time of writing.

GRAIN STORAGE

The trials on the underground pit storage of maize referred to in the Annual Report for 1952 were brought to a close during the current year. The storage periods in the three 120-ton pits constructed were 379, 446 and 466 days respectively. Complete elimination of the weevil population by accumulation of respiratory carbon dioxide occurred in all three pits although owing to constructional or sealing faults small numbers of the flour beetle, *Tribolium castaneum* Hbst., survived in one of the pits. Apart from the loss of some two tons of grain due to a local constructional fault in one pit which allowed the entry of water the maize removed at the end of the trials from all three pits was in a very satisfactory condition and considerably better than would have been the case had it been stored in bags in a conventional godown. The practical utility of underground storage in Tanganyika can now be considered established.

It is hoped to carry out additional pit storage trials in 1954 with maize of high moisture content.

CASHEW PESTS

The cashew nut industry has of recent years assumed increasing importance in the economy of the territory, exports of nuts to processing factories in India rising from approximately 3,500 tons in 1947–48 to 10,000 tons in 1952–53.

The main pests found at Lindi where the bulk of the cashew crop is produced were a new species of *Helopeltis*, described by Mr. Miller of the Commonwealth Institute of Entomology in a paper submitted to the Bulletin of Entomological Research and an at present unidentified coreid bug.

As a result of its sucking habit *Helopeltis* is responsible for a considerable amount of die-back of young inflorescence stalks and pedicels and the death of young nuts. Similar damage is caused by the unidentified coreid referred to above although being less numerous it is responsible for less damage.

Sucking bug damage has been found on the kernels themselves the incidence varying in the 1953 season from 1·0 per cent to 13·2 per cent with an average of 5·2 per cent. In unripe kernels the damaged area is in the form of a sunken pit greenish-yellow at the bottom and with irregular radiating cracks on the walls. In mature kernels the colour of the sunken damaged area changes to a dark brown or black. In some cases this damage is associated with a fungus, *Nematospora coryli*, which by analogy with other crops, e.g., coffee, beans and cotton, is probably transmitted by the insect responsible for the kernel damage. No microscopic differences could be detected between damage with which *Nematospora* was associated and that without it.

In bagging experiments with *Helopeltis* (all stages) the unidentified coreid (all stages) and a commonly occurring Tettigrometrid, *Hilda patruelis*, Stal. found on the inflorescences, kernel damage was only obtained in one experiment using an adult coreid. This damage appeared directly beneath the point of entry of the insect's stylets as shown by a lesion on the pericarp and was not associated with the *Nematospora* fungus. Further work is planned on the kernel spotting damage and on the ability of the various sucking bugs to transmit *Nematospora* fungus.

Survey of Crops and Insect Damage

Cereals.—Heavy attack by the stalkborer, *Busseola fusca*, F., has again been reported from Mwanza (Lake Province) and Urambo and Tabora (Western Province). Detailed investigation on this pest is planned for early 1954.

Army worm, *Laphygma exempta*, Wlk., caused extensive damage to young maize and sorghum and to grazing near Tabora. At Mvomero in the Eastern Province a heavy local infestation at the beginning of the year was followed by a more widespread one on native plantings coinciding with the beginning of the main rains in March. Prompt dusting with a mixture containing 10 per cent DDT plus 3 per cent gamma BHC brought the infestation under control. A further outbreak in the same area occurred at the end of the year associated with the onset of the short rains; widespread damage was reported at the same time from Kilosa District.

Repeated plantings of maize and sorghum in the Morogoro–Mvomero–Turiani Districts were occasioned by the depredations of the small grey field mouse, *Mastomys microdon coucha*, which occurred in plague numbers. Extensive baiting with a barium carbonate/maizemeal mixture had variable success and it is proposed in future to experiment with baits containing Warfarin.

Large populations of American bollworm, *Heliothis armigera*, Hbn., were observed on plantings of compact-headed types of short-term sorghums at Nachingwea, Kilosa and Mwanza. At the two former places there was evidence that this build up was responsible for later attacks by the insect on experimental blocks of cotton.

Legumes.—The coreid bug, *Acanthomia tomentosicollis*, Stal., was identified as causing damage to pigeon pea at Urambo in Western Province and the related *A. horrida*, Germ. found in large numbers on irrigated cow pea at Morogoro together with *Riptortus dentipes*, Fabr. and *Cletus* sp. *A. horrida* is known to transmit the fungus, *Nematospora coryli* responsible for bean yeast-spot. In cage tests with *Riptortus* necrotic lesions were produced on cow pea seeds and on dwarf bean seeds but no examination was made for the presence of *Nematospora* fungus.

Canadian wonder and haricot beans at Iringa and the off-season bean crop at Ruanda in the Kigoma District were attacked by the Agromyzid *Melanagromyza phaseoli*, Coq. whilst the leaf-eating Galerncid *Ootheca bennigsenni.*, Wse. was reported in numbers on dwarf beans and cow pea from Mbeya, Tabora and Morogoro Districts. A dieldrin dust applied at the dosage of six ounces of actual dieldrin per acre proved effective against this insect in Morogoro but showed little persistence owing to heavy rain occurring at the time of dusting.

Rosette, transmitted by *Aphis laburni*, Kalt., was reported as severe on early planted groundnuts in Tabora District.

Cotton.—The Lake Province crop was generally free of pests, a fact which was attributed to the dry conditions prevailing; a general low incidence of pests was also reported from the Eastern Province and coincided with a higher than average yield. Heavy local damage to experimental blocks of cotton at Nachingwea was caused by *Heliothis armigera*, Hbn. A small quantity of cotton at Tunduru became heavily infested with the cotton aphis, *Aphis gossypii*, Glover.

Miscellaneous Reports

Larvæ of the Lymantrid moth *Euproctis rubricosta*, Fawcett. were observed in large numbers eating the leaves of castor at Turiani and Kisarawe whilst damage by the cossid stem borer *Xyleutes capensis*, Wlk. was noted in Morogoro. A scale insect *Aonidiella orientalis*, Newst. was reported in numbers on the stems of castor at Dodoma.

The cetoniid beetles, *Rhabdatis sabrina*, G & P. and *Diplognatha silicea*, Mac Z. were observed eating young flowers of mango in Morogoro whilst an unidentified capsid bug caused damage to the young leaves. A scale insect, *Saissetia zanzibarensis*, Williams., recently described as a new species from Zanzibar was found on mango at Mvomero in Eastern Province associated with the ant *Oecophylla longinoda*, Latr.

A rise in the incidence of robusta coffee beans damaged by the borer, *Stephanoderes hampei*, Ferr. was reported from Bukoba; it was stated that this increased damage occurred whilst the coffee was being held in store by native growers pending an anticipated rise in price.

Additions to the List of Injurious Insects

Commotria sp.? *albistria*, Jause (Pyralidae)—larva boring in maize stalks.
Saissetia zanzibarensis, Williams. (Coccidae)—sucking young stems of mango.
Diplognatha silicea, Mac. Z. (Cetoniidae)—eating young mango flowers.
Helopeltis sp. (new species) (Miridae)—causing cashew stem die-back.
Gyponychus socius, Hust. (Curculionidae)—cashew leaf-eating beetle.
Alphitobius diaperinus, Panz (Tenebrionidae)—stored rice.

Acknowledgments

The Director and staff of the Commonwealth Institute of Entomology have once again given valuable assistance with the identification of insects.

G. Swaine,
Entomologist

ANNUAL REPORT OF THE ENTOMOLOGIST, LYAMUNGU, FOR THE YEAR 1953

Movements

Mr. A. J. Jones was on duty until the third week in March when Mr. R. G. Tapley returned to the station from leave. The coffee districts in the Southern Highlands were visited during a five weeks' safari in October and November.

Coffee

White Coffee Borer, *Anthores leuconotus*, remained the most serious pest of coffee throughout the year and continued to cause extensive damage. The labour shortage is inducing farmers to take a direct interest in chemical control of the insect.

An experiment was laid down by Mr. Jones during the end of 1952 and was evaluated by him in March, 1953. Dieldrin emulsion was used at the 1 per cent and ½ per cent levels and DDT at the 2 per cent and 1 per cent levels and applied to the lower eighteen inches of the stems at the rate of approximately 200 c.c. per tree. A resin (15-9 L/P of Petrochemicals Ltd.) was previously added at the rate of one part to seven parts of insecticide W/W. Each treatment was replicated twice in each of three estates. Plots contained five × five—twenty-five trees and were randomized.

Results which were evaluated by examining each tree for living or dead larvæ (all eggs having hatched) are summarized as follows:—

Treatments:	2% DDT		1% DDT		1% Dieldrin		½% Dieldrin		Control	
Replicated Number	*Larvae* a.	d.	*Larvae* a.	d.	*Larvae* a.	d.	*Larvae* a.	d.	*Larvae* a.	d.
1	0	0	0	4	0	0	0	0	5	0
2	0	1	0	0	0	1	0	0	5	0
3	1	0	2	0	0	1	0	2	2	0
4	1	1	3	1	0	0	0	2	14	0
5	0	0	0	1	0	1	0	1	6	0
6	0	0	0	0	0	0	0	1	3	0
Total	2	2	5	6	0	3	0	6	35	0

Note: a. = alive; d. = dead.

No attempt was made to analyse these figures statistically but it can safely be concluded that all treatments were better than control and Dieldrin emulsion at 1 per cent and ½ per cent levels were definitely better than DDT at 2 per cent and 1 per cent levels. This largely confirms by another worker the results published in the report for 1952. The experiment also confirmed the observation that a high proportion of ringbarking larvæ were destroyed in treated stems as opposed to untreated stems, presumably due to insecticides absorbed in the bark.

As a result of this and previous experiments and work referred to later in this report, a small pamphlet entitled "Chemical Control of Borer—The Present Position" and published by the Tanganyika Coffee Growers' Association was circulated to coffee farmers. This contained a summary of the present known data on the chemical control of borer and pointed out the gaps in our knowledge

The more outstanding points contained in the summary are as follows:—

(1) Both DDT and Dieldrin are effective in borer control. One experiment has shown that 2 per cent Dieldrin is significantly more efficient than 2 per cent DDT, and that $\frac{1}{2}$ per cent Dieldrin is better than 1 per cent DDT. Dieldrin at $\frac{1}{2}$ per cent is in fact almost as efficient as 2 per cent DDT. All experiments indicate the superiority of Dieldrin over DDT.

(2) DDT and Dieldrin control the beetle by a direct effect. The females are particularly susceptible when they bite away treated bark in preparation for egg-laying. Ring-barking larvae are also susceptible, presumably due to the insecticide absorbed by the bark.

(3) Females can always lay one or more eggs after coming into contact with the insecticide regardless of the amount applied.

(4) The optimum time for spraying is just before the main beetle emergence in late November and December.

As little information as to the optimum amount of insecticide to use could be expected from further small scale trials conducted from this laboratory planters were asked to co-operate in forming one large trial in the Northern Province by treating multiples of five acres of coffee with insecticide, using the insecticide at rates as recommended by the entomologist who would arrange the experiment and co-ordinate results. Thirty-four planters agreed to conduct trials and if carried out as arranged the experiment should extend over 360 acres of coffee, giving twelve replicates of four Dieldrin rates and two DDT rates. Also lower coffee on the Coffee Research Station has been treated.

The Dieldrin arrived in the country later than could have been wished although in time for the main beetle flying season but many planters delayed spraying owing to limited labour, the pressure of other work, and in some cases forgetfulness. It is feared therefore that results may not be so useful as could have been wished.

The behaviour of DDT with and without a sticker in the bark of coffee is being studied in conjunction with the chemist of the Colonial Insecticide Research Unit, Arusha. A series of observations have been made over a period of nine months and are still being continued. There is a high initial decline in quantity of insecticide in the bark followed by a long period of a slow decline. There is always a surface deposit of DDT and it appears that the bark acts as a reservoir. A full report will be issued when the work has been completed.

A number of tests have been made with lacquers charged with insecticides against the borer beetle. The initial tests with these products were made by the Colonial Insecticide Research Unit at Porton in the U.K. The lacquers when applied have the appearance of ordinary lacquers but if the surface is disturbed by as little as a walking insect very minute insecticide crystals bloom on the surface and are lethal to any insect which happens to pass. The lacquers used contained 20 per cent DDT, 10 per cent Dieldrin, 10 per cent Aldrin and 5 per cent BHC

respectively. Each were sprayed on the stems of coffee trees in April but by that time not enough test insects were available. Other trees were treated in December and comparative trials are now being made and full results will be published later. Results at hand show the lacquers to be very effective against the beetles, DDT and Dieldrin still being as active after nine months' exposure in the field as after two weeks' exposure. There is a tendency however for an alga to overgrow the lacquers which may eventually mask the insecticides. No phytotoxic effects on the treated trees were noted. The possibilities of using the lacquers in the household on such articles as meat-safes to control ants and cockroaches is being tested.

The use of Hanane in 6 gm. capsules for soil application as supplied by Pest Control Ltd. was unsuccessful against ring-barking larvae in one small trial. This preliminary test made early in the year is now being followed up by others.

An attempt was made to destroy ring-barking and wood-boring larvae *in situ* with electricity from a car distributor for varying periods. Some ring-barking larvae were stunned but soon recovered. Wood-boring larvae were not affected at all. The trees were not damaged in any way. The possibility of using high frequency current was put to the Electrical Research Association, U.K., but it was considered that the system has not been sufficiently developed for field trial here.

During the year an attempt has been made to detect accurately and quickly borer in coffee trees. The P.D. was measured in coffee trees (c.f. Parr, Thaddeus "Voltage Gradients in trees as an Indication of Susceptibility of Insect Attack"—*Journal of Forestry* 41,417-26). A variation in P.D. in adjacent trees was noticed but it was not possible to continue researches without more sensitive apparatus which was ordered but which did not arrive during the year. Another method which was considered but not tried was detecting larval movements with an amplifier system. Unfortunately it is not easy to obtain special apparatus of this nature quickly. (Both these methods were suggested by the entomological staff at the U.K. Forest Products Research Laboratory). Tests have shown that visual detection of borer by experienced operators is rarely more than 60 per cent efficient and often as low as 35 per cent.

Resistance of Robusta Rootstock to Borer

The stems of four *arabica* trees with *robusta* root stocks were infested with borer eggs, borer beetles being enclosed in a cage surrounding the stems. Eggs were laid in both the stock and the scion in approximately equal numbers. Soon after the eggs were laid in the robusta the bark split open thus exposing the eggs which dried out. In the *arabica* the eggs hatched and the larvae started ring-barking normally but refused to enter the root-stock although most larvae tend to ring-bark down the stem towards the roots. A small number of ring-barking larvae were left in the scion of two trees and these entered the wood normally. They were however destroyed in error by the borer-control gang.

It would appear therefore that while *robusta* shows no resistance to the ovipositing beetle it does show resistance to the eggs by exposing them to the outside world and by being distasteful to ring-barking larvae. The *robusta* stock however does not impart any of its resistant qualities to the *arabica* scion.

Antestia

An attempt was made to control *Antestia lineaticollis* with DDT applied with a Swingfog applicator. 340 gms. of 80 per cent p.p. DDT was dissolved in three litres of best grade diesel oil and applied at the rate of thirteen ounces of DDT per acre of coffee (the quantity normally applied in an emulsified form). The results were as follows:—

Number of *Antestia*	before treatment	0·9 per tree
,, ,, ,,	24 hrs. after treatment	0·7 per tree
,, ,, ,,	7 days after treatment	0·3 per tree
,, ,, ,,	14 days after treatment	0·2 per tree
,, ,, ,,	21 days after treatment	0·3 per tree

As the tolerance level for *Antestia* is 0·3 per tree control was not satisfactory.

The Chemist, Colonial Insecticide Research Unit, found that samples of leaves taken from plot seven days after treatment showed a residue of 6·1 mgm. DDT per square foot. It is not known how this residue compares with normal emulsion spraying. Trials with other insectides are continuing. A pyrethrum extract was also put through "Swingfog" and the heat generated did not seem to affect the knocking down qualities of the insecticide against house flies.

All reports of *Antestia* developing resistance to DDT have been investigated and again each case has been due to faulty application of the insecticide and not due to any build up of immunity.

Tests made with two lb. of 50 per cent DDT dispersable powder per acre (c.f. with thirteen ounces in emulsion form) have given inconsistent results and it is still recommended that emulsion should be used.

Orthezia Insignis

More predators, *Hyperaspis jocosa*, were distributed during the early part of the year and in some places where it has been introduced the *Orthezia* is being brought under control. No further breedings of the predators will take place at Lyamungu owing to the diminished food supply and pressure of other work.

Green Scale

The identity of Green-Scale was checked and was found to be *Coccus viridis* and *C. africanus*. The difference between the two species is very small being the number of divisions in the atennae only. The best method of controlling this pest is by spraying the lower nine inches of the stem of each tree with a 1 per cent Dieldrin emulsion, and by spraying the whole tree with a 2 per cent white oil emulsion if the parasites, predators and entomophogous fungi are slow in assuming control and by avoiding the use of DDT on the foliage.

General

A project for studying the eco-climates of the coffee tree has been initiated and it is hoped to correlate this data with insect and mite populations and other factors wherever possible. Apparatus has been built for measuring temperatures of different parts of the tree and has been set up in the field. The apparatus is still being tested for accuracy and reliability. Some leaf temperatures have been found to exceed 40°C. The work is complementary to Kirkpatrick's work at Amani in 1933. (Bulletin of East African Agricultural Research Station, Amani, 1935). The first part of the study will be the investigation of factors affecting borer beetle emergence.

The Insecticide and the Tree

The stem application of both DDT and Dieldrin has not induced any consistent taints in the liquor over a two years' period. Of thirty-eight samples taken in 1953, nineteen were returned as clean, four as slightly bricky (bricky is normally a B.H.C. taint) and fifteen having slight or very slight unclassified flavours. Brickiness was detected in this particular plot more than two years ago.

Tests with BHC and lindane have shown that both can induce a severe bricky taint particularly in foliage applications. Tests were also made with chlorinated camphene and aldrin but liquoring tests have not yet been completed.

DDT applications in the soil at the rate 100 and 200 lb. DDT per acre have not had any observable effects on the coffee trees in the second year of treatment.

OTHER CROPS

Wheat and Barley

Severe local damage was caused to wheat and barley seedlings by two species of black soil-living bugs, *Cydnus indicus* and *Cydnus* sp. ? The damage was noticed too late to try any control measures but trials with seed-dressings will be made in 1954.

An outbreak on barley of the Aphid, *Rhopalosiphon maidis* appeared too late to do any damage. It can feed only on growing shoots but not the ear and young leaves.

Peas

Outbreaks of the Pea Aphid, *Acyrthosiphon pisum*, have appeared almost everywhere where peas were grown. DDT emulsifiable concentrate sprayed at the rate of 1 lb. of actual DDT in twenty-five gallons water per acre (as recommended in the U.S.D.A. Farmers Bulletin No. 1945) gave a fair control. Aphid populations were reduced from 4,300 insects per sweep of 180° with a collecting net of twelve inches diameter to 154 per sweep twenty-four hours after spraying. In treated areas dead aphids could be picked up in handfuls from depressions such as tyre marks in ground.

Papaw

A pest new to papaw, *Tetranychus equatorius* Mac. G., (Tetranychid) caused severe damage on one estate to young papaw plants which were in the early flowering stage. The planter cultivating the crop sprayed a copper formulation on the young papaw against leaf mildew and he included DDT in the spray as a prophylactic against any possible insect pests. This resulted in a very severe outbreak on the treated young trees, but not on the unsprayed mature trees. The outbreak was controlled with lime sulphur concentrate diluted thirty times with water, to which "teepol" was added at the rate of three-quarters pint teepol per forty gallons of diluted spray. This was applied at a high pressure in order to penetrate the mites' web. Lime sulphur without the spreader was not so effective. A second application after a ten to fourteen day interval gave a complete control.

A mite outbreak was also induced on mature papaw in a garden by spraying with Toxaphene.

The mite has since been found in small numbers on almost every papaw plantation examined and it seems likely therefore that it is an indigenous pest and yet this is its first record on papaw and the second record in Africa, the first being on cotton in Uganda.

ACKNOWLEDGMENTS

Acknowledgments are due to Mr. R. W. Forder of Valentine & Co. for liquoring many samples of tainted coffee. To Pest Control Ltd., Plant Protection, Petrochemicals and Shell Chemicals and Universal Crop Protection for the supply of materials and their helpfulness during my leave in the U.K. To the Commonwealth Institute of Entomology for identifying numerous specimens, sometimes at very short notice. To the staff of Imperial College at Silwood Park, and the entomological staff of the Forest Products Research Station for many useful suggestions and technical assistance. Also, to my colleagues in the department and on the Coffee Research Station and Colonial Insecticide Research Unit, Arusha, for every assistance.

R. G. Tapley,
Entomologist.

ANNUAL REPORT OF THE ENTOMOLOGIST, ARUSHA, FOR THE SEASON 1952–1953

Movements

The last two months of 1952 and the first three months of 1953 were spent at the Coffee Research Station, Lyamungu, replacing Mr. Tapley while he was away on long leave. The remainder of the year has been spent at Arusha. Results of the work carried out while stationed at Lyamungu are contained in the report of the entomologist, Lyamungu.

Safaris have been made to Iringa, Mbulu, Oldeani and Babati areas.

Bean Pests

The greater part of the writer's time has been spent identifying bean pests, assessing their effect on bean production and devising methods for their control. It has become increasingly apparent however that no single widespread pest of beans exists in the Northern Province but that every year the crop suffers heavy losses from one or another of the pests which have been identified.

To illustrate this point; in the 1951 growing season the entomologist, Lyamungu, found three Noctuid moth caterpillars feeding on the leaves and pods of beans:—

Laphygma exigua Hubn. (Amphipyrinae)
Prodenia litura. F. (Amphipyrinae)
Phytometra orichaleea F. (Plusiinae).

No accurate assessments of damage done were made but it was evident that there was resultant loss of crop.

The writer was posted to Arusha for the 1952 growing season and found that the main damage to beans was caused by the following species of Hemiptera:—

Acanthomia horrida Germ. (Coreidae) recorded previously, once only, as damaging beans in Italian Somaliland in 1937. *Nezara viridula* L. (Pentatomidae) and *Acanthomia tomentosicollis* Stal. (Coreidae), previously recorded as damaging beans in South Africa.

In the 1953 season two species of Noctuid moth caterpillars caused considerable damage to beans:—

Heliothis armigera Hubn. (Amphipyrinae), "the American Boll Worm", boring through the bean pods and feeding on the seeds thus causing characteristic holes to appear in harvested seed, and *Phytometra orichalcea* F. defoliating the bean plant. All the species of Hemiptera mentioned above were present in the 1953 seasons but in small numbers only.

The incidence of one or another of the above pest complexes in any year seems to be dependent upon the intensity of rainfall in that year.

Hemiptera.—It is evident now that many species of Hemiptera can produce the "yeast spot" symptoms on the cotyledons of bean seeds which were previously attributed to the activities of the "Green Stink Bug" *Nezara viridula.* It is now considered that *N. viridula* is of minor importance in producing these

symptoms since its population level has always been low in the fields. The other *Hemiptera* mentioned above appear in very large numbers in some years and bring about serious deterioration of crop quality.

Symptoms of Hemipteran attack are:—

1. Dimpling of the seed coat.
2. Browning and shrivelling of the seed.
3. Wrinkling of the seed coat.

Dimpling and browning and shrivelling are caused by transmission of the fungus *Nematospora coryli* into the cotyledons, the latter symptoms being a more advanced stage than the former probably due to earlier attack on the seed. Fungus is rarely present when the seed coat shows wrinkling and it is thought that this symptom is produced by the toxic action on the cotyledon of the saliva of the bug.

Germination tests with seeds showing the above symptoms and with normal seeds of the same variety and origin gave the following results:—

Seed Type	*Germination*
1. Normal	93%
2. Dimpled	32%
3. Browned and Shrivelled	11%
4. Wrinkled	27%

The economic effects of Hemipteran damage in the bean crop thus are:—

All disfigured seed are rejected as seed produce, their value thus decreasing greatly. The following percentage by weight figures of analyses of random samples of bean seed taken at harvest from various farms illustrates the loss that can ensue from such damage:—

Samples	*Seed*	*Rejects due to Hemipteran activity*	*Rejects due to other causes*
1.	32·2%	... 46·3%	... 21·5%
2.	44·4%	... 51·0%	... 4·6%
3.	41·6%	... 53·4%	... 5·0%
4.	64·7%	... 32·4%	... 2·9%
5.	64·04%	... 25·4%	... 10·56%

Serious reduction in germinating capacity of damaged seed. All the above mentioned *Hemiptera* are able to carry-over between crops on weeds and have been seen to move into bean fields from the surrounding weeds.

Lepidoptera.—Of the two noctuid caterpillars seen attacking beans it has been possible to roughly assess the widespread damage caused by the American boll worm only. The defoliating activity of *Phytometra orichalcea* undoubtedly reduced the vigour and productivity of plants but the damage caused was inestimable. Estimations of loss due to American boll worm are subject to a great deal of error and tend to give a diminutive evaluation of the amount of damage really caused. The caterpillar together with burrowing into the pod and eating a hole in the seed, often enter a pod and destroy the whole contents, and often chew young pods near the stalk causing a complete halt in their development. Assessments of visible damage were, however, carried out by taking random samples of beans at harvest time, sorting and counting the number of American

boll worm injured seed and multiplying this by the average weight of one undamaged bean seed of the same sample. The following are examples of results obtained expressed as percentage loss by weight:—

Samples Undamaged by Insects	*American boll worm Damage*	*Hemipteran Damage*
1. From a 90-acre Block 64·22%	... 35·57%	... 0·21%
2. From a 60-acre Block 59·74%	... 38·32%	... 1·94%
3. From a 66-acre Block 78·35%	... 20·48%	... 1·17%
4. From a 40-acre Block 87·79%	... 10·89%	... 1·32%

Coleoptera.—Each year a considerable loss of crop is caused by the following species of Meloidae:—

Mylabris tristigmata Gerst.
M. aperta Gerst.
M. amplectens Gerst.
M. severeni Pie.
Cylindrothorax strangulata Gerst.
Epicauta albovittata Gestro.

These beetles appear in large numbers feeding voraciously on blossoms and young pods. Numerous small Galerucid beetles, *Monolepta* sp., invaded some fields and rapidly defoliated small areas of plants. They were controlled quite effectively using a DDT emulsion and knap-sack sprayers.

Thysanoptera.—A species of thrips (as yet unidentified) has appeared in very large numbers on some small areas of beans growing towards the end of the season usually after a spell of dry weather. Owing to the feeding of the thrips the plants and pods become stunted and unproductive so that in one case experienced thirty to forty acres of beans were ruined. Spraying with a low volume sprayer (without drop legs) at five gallons of DDT emulsion per acre depositing approximately 1 lb. of actual DDT per acre, gave good control of nymphs but poor control of adults.

Control of the Major Bean Pests in the Field

Control of these bean pests demands a good coverage of the bean pods themselves which are always found beneath the leaf canopy of the plant. Normal straight boom spraying machines will not give the coverage required since most of the spray droplets are deposited on the upper surfaces of the upper leaves.

In the 1952 growing season it was impossible to adopt control measures against the sucking bugs since no spraying machines were available. In the 1953 season however many farmers purchased low volume sprayers to be used primarily for weed control in maize. One such machine was adapted for underleaf bean spraying by making an entirely new boom and drop-legs from half-inch diameter galvanized metal piping and spare jets. This enabled spraying above and between the bean rows. During the caterpillar outbreak of 1953 this machine did excellent work on many farms applying approximately three-quarter lb. of actual DDT in fifteen gallons of emulsion per acre.

It is thought that this spraying technique with varying dosages of insecticides will effectively control all the major bean pests. It is planned however to compare the efficiency of the above-mentioned sprayer with other types of ground sprayer, aerial spraying and dusting.

Stored Beans

Random samples of bean seed have been collected from various areas at harvest time and kept in a constant temperature room in sealed aerated bottles. It will be noted whether or not Bruchid beetle infestation will develop.

Random samples of beans have also been taken from different levels in a fumigation chamber after fumigation with carbon bisulphide at the rate of two gallons per 4,000 cubic feet for six days and treated in the same way as above. The field samples have already been kept for five months and the fumigation chamber samples for three months. No Bruchid beetle infestation has yet been detected in any of the samples.

Maize

This crop has been studied under both European and African conditions in the Arusha and Mbulu districts. In the Arusha District heavy infestations of stalk-borer have appeared on some European farms where it has been almost unknown in the past.

In the Mbulu District it has been confirmed that maize trash-bunds are an important carry-over site for stalk-borer. Many stalk-borer pupae have been found in the dry maize stalks comprising the bunds though distribution of the pupae was very uneven from one African farm to another. It has been agreed however that since contour bunding is such a valuable contribution to soil conservation it is inadvisable to discourage the practice. It is suggested that anti-stalk-borer measures by chemical means should go hand in hand with maize trash-bund production.

Swamp maize was also investigated as a possible site for stalk-borer carry-over. Three nearly full grown larvae only of *Busseola fusca* Fuller were found during the whole survey of many acres of maturing and young swamp maize. It seems therefore that this type of maize does not constitute an important stalk-borer carry-over site.

Experiments and demonstrations on stalk-borer control have been arranged in co-operation with the Agricultural Officer, Mbulu.

Cutworm also is a serious pest of maize and beans in the Mbulu area therefore similar experiments and demonstrations have been arranged on its control.

Two and half per cent DDT powder or Derrisol placed in the funnel of each maize plant and a gammexane bran bait have been advised for stalk-borer and cutworm control respectively on African farms. These methods however have proved too tedious in operation on the larger European farms. It has thus been arranged to try out control measures on European farms using a large power-driven dusting machine.

Tobacco

Experiments on cutworm control have been laid out in Iringa in co-operation with the Agricultural Officer (Experiments) of that district. Treatments used were 2½ per cent Toxaphene, 5 per cent Toxaphene, 2½ per cent Aldrin and 2½ per cent Dieldrin dusts placed in the planting holes whilst planting out seedlings. This experiment followed on from the 1952 experiments in which 10 per cent Toxaphene and a gammexane bran bait proved useful control methods. Control over large areas was also tried using the dusts and method mentioned above.

No results were obtained from these experiments since no cutworm appeared on the experimental farm during the season.

Successful results from cutworm control experiments in the Mbulu area will be sent to Iringa for application there.

Sugar Cane

The normal practice for control of "white grub," *Cochliotis melolonthoides* Gerst. (Melolonthinae), at Arusha Chini is the application of one cwt. of Agrocide 7 per acre spread evenly over the cane cuttings in the furrows. This method gives good protection of plant cane but not of ratoon cane the yields of which are reduced by approximately a half.

An insecticide trial has been laid out in the form of a 5×5 Latin square using one cwt. of Agrocide 7 per acre and one cwt., half-cwt. and quarter-cwt. of a 2.5 per cent Aldrin dust per acre, using the normal method of application practised with Agrocide 7. The experiment covers approximately four acres, the expected plant cane yield for analysis being approx. 200 tons.

The object of the experiment is to find an insecticide which might with one application only protect both plant and ratoon cane economically.

The writer was also approached on the possibility of spraying the adult chafer beetle from the air during its swarming period at the onset of the short rains. After investigations however it has been decided that aerial spraying during swarming would be impracticable for the following reasons:—

The beetles swarm for twenty to twenty-five minutes only from 18-35 hours to 19-00 hours approximately. It is therefore impossible for a plane to fly at this hour in an attempt to obtain a direct contact kill of beetles with insecticide owing to approaching darkness.

Since the swarming beetles do not appear to alight upon or feed on any plants it would not be possible to spray before swarming and depend on the residual effect of an insecticide to give adequate kill.

Minor Pests

Citrus Scales.—Small scale experiments have been carried out against *Chrysomphalus ficus* Ashn, and *Lepidosaphes beckii* Newm. on oranges. A 2 per cent concentration of a new white oil formulation gave good control after two applications.

Sisal Scale.—Small outbreaks of this scale *Aonidiella orientalis* Newst. were found at Temi. A 2 per cent white oil emulsion and a 0.0125 per cent solution of Pestox 101 were used in an attempt at control but neither had any marked effect.

Fruit Fly on "Gelouda" Plant.—An area of plant, identified as *Cephalandra quinqueloba* Schred producing small cucumber-like fruit was inspected and found to be heavily infested with the fruit fly *Dacus ciliatus* Loew. Cleaning up and burning of all rotting damaged fruit produced effective control.

A mealy-bug *Ferrisiana virgata* was found also causing die-back of the same plant. It was controlled to a small extent with a 2 per cent white oil emulsion.

Army Worm.—Army worm, *Laphygma* sps., appeared on some farms after the onset of the short rains and devoured small areas of pasture. No control measures were necessary.

A. J. Jones,
Entomologist.

ANNUAL REPORT OF THE PLANT PATHOLOGIST FOR THE YEAR 1953

Staff

Dr. G. B. Wallace, Plant Pathologist, and Mrs. M. M. Wallace, Temporary Scientific Assistant, were on duty throughout the year. On 14th October the former was appointed Acting Senior Research Officer in charge of the Coffee Research Station, in addition to continuing his other duties.

Mr. N. B. Joy, Plant Pathologist, arrived in the territory on first appointment on 29th September having completed post-graduate courses of study in Trinidad and at Cambridge. He spent a month at Lyamungu studying laboratory and office routine and local literature on plant diseases. On 27th October he transferred to Arusha where laboratory accommodation has been provided by the kind favour of the Director of the Colonial Insecticide Research Unit. At Arusha Mr. Joy has been engaged on routine advisory work and seed testing.

The work of two laboratory assistants is worthy of mention. Mr. Basil A. Kalisti has performed a wide range of laboratory duties with efficiency, while Mr. Marko Kristonsia has shown particular aptitude in diagnosing plant diseases in the field.

Acknowledgments

Thirty-five specimens were submitted to the Commonwealth Mycological Institute, Kew, for identification or confirmation and grateful acknowledgment is made to the Director and staff; and also to other specialists elsewhere for identifications: Dr. W. J. Dowson, Cambridge, Dr. W. L. Gordon, Winnipeg, Dr. V. A. Wager, Durban, Dr. Anna E. Jenkins, Washington, and Dr. A. Bitancourt, Sao Paulo.

Touring

Short visits were made by the Plant Pathologist, Lyamungu, to the Arusha District on several occasions and to the Lushoto and Morogoro Districts. The Temporary Scientific Assistant visited Turiani and Morogoro.

Meetings attended by the writer were those of the Tanganyika Seeds Board in May, the Tanganyika Coffee Growers' Association in October, the Tanganyika Coffee Board in December and the Conference of the Specialist Committee on Agricultural Botany at Muguga, Kenya, on 23rd November, Mr. N. B. Joy attended meetings of the Tanganyika Seeds Board in October and December.

Publications

The following were published by the laboratory staff:—

Parts II and III, Departmental Pamphlet No. 52 "The Papaw: its Botany, Cultivation, Diseases and Chemistry".

Departmental Pamphlet No. 53 "Diseases of Sorghum".

Departmental Pamphlet No. 55 "Magonjwa ya Mtama".

Departmental Pamphlet "Maradhi ya Panama ya Migomba".

Mycological Circular No. 32: "Die-back in coffee: relation of pruning methods to forms of the disease".

Mycological Circular No. 33: Recent Records No. XVI.

Mycological Circular No. 34: Recent Records No. XVII.

Commonwealth Mycological Paper No. 51: A supplement to a list of plant diseases of economic importance in Tanganyika Territory; Commonwealth Mycological Institute, Kew, Surrey.

"Brown Spot of Maize", East African Agricultural Journal XIX, 2, October, 1953.

In the Press is a departmental leaflet "Instructions to collectors" (in collaboration with R. G. Tapley, Entomologist).

In typescript is a paper on Papaw Scab (in collaboration with Dr. Anna E. Jenkins and Dr. A. Bitancourt).

Papers on plant diseases were read at meetings of the Tanganyika Coffee Growers' Association at Arusha on 17th July and of Arusha planters on 20th September. A number of demonstrations of plant diseases were given at the laboratory including one in March to the class attending a course in soil conservation at Tengeru.

Laboratory Work

As a measure of how the work of the laboratory has increased in recent years the total number of items of correspondence registered in 1953 was 2,419; in 1950 it was 1,804 and in 1948 the figure was 1,462. Among 447 specimens of plant diseases examined at the laboratory thirty-one proved to be new records for the territory while twenty-five are new local host records for parasites already known here. These are listed at the end of this report. In the diagnosis of plant disease specimens 194 pure cultures were prepared.

Twenty-four tests of seed samples for germination and presence of disease were made for growers. Cultures of Rhizobium for legume inoculation were maintained and forty-four tubes were supplied.

Diseases dealt with are referred to below under their host plants in alphabetical order. The weather during the year was comparatively dry, as in the previous year. Most of the diseases listed have been discussed in Mycological Circulars Nos. 33 and 34 which were published during the year so the reviews are shorter than would otherwise have been necessary.

Banana.—There has been a little inevitable extension of the earlier wilt (Panama disease) infected areas near Moshi but the only new site is at Pongwe near Tanga. The destruction of infected plants as they are observed has continued successfully. It is of interest to record that the cleaning up of banana fields for wilt control has been extended to weevil control and general renovation of the plantations with very satisfactory results, particularly in the Lushoto District but also in other districts of the Northern and Tanga Provinces. If the enthusiastic efforts of the agricultural staff with the collaboration of the Native Authorities and growers are continued and extended there should be a very appreciable increase in banana production.

An apparently new species of Cephalosporium was isolated from rotted rhizomes of banana; its significance is not yet known. The saprophyte *Zygosporium oscheoides* was found on dead areas of banana leaves.

Barberton Daisy.—Verticillium albo-atrum was isolated from wilting plants. This species is a known cause of wilt in cotton and other plants and the present isolation was found capable of infecting cotton seedlings. Symptoms in Barberton daisy in addition to wilting were yellow mottling of the leaves which had brown dry and brittle edges and brown discoloration of the vascular system of the roots and collar visible when the plants were split. This was due to the presence of a dark "gummy" substance and dark fungus hyphae in the vessels. Affected plants should be taken up and destroyed.

Begonia.—Leaves showed a rot caused by *Glomerella cingulata* in the rainy season.

Bonavist bean (*Dolichos lablab* or "Fiwi" bean)—Rust—*Uromyces vignae* was recorded on this host.

Cashew.—Yeast spot caused by *Nematospora coryli* was found for the first time in cashew nuts. It causes a black marking of the kernels which lowers their value to buyers. The insect vectors of the fungus are being studied by the entomologist, Morogoro.

Several other fungi have been found in cashew nuts; these include *Aspergillus niger* and this strain was found capable of initiating the characteristic bole rot of sisal.

Castor.—Bacteria isolated from leaf-spots on castor have proved on different occasions to be the saprophytic species *Bacterium lathyri* and what may be *Pseudomonas aleuritidis.*

Cenchrus ciliaris.—On this grass the smut *Sorosporium penniseti* was found.

Citrus.—A collar rot of budded orange and seedling lime was associated with the presence of *Fusarium solani* sensu Snyder and Hansen. The fungus was isolated from internal wood and was also found sporing on the root surface. The disease is thought to have been encouraged by severe drought followed by very wet conditions.

The virus disease "Stem pitting" was found in grape-fruit at Morogoro and Lyamungu and to a lesser extent in lemon, lime and orange at Morogoro. The grape-fruit at Morogoro appears to have a mild strain of the virus infection with which is thought to confer immunity to the severe strain. The trunks and main branches show characteristic depressions on the surface while the wood below has diagnostic grooves and ridges. Trees with the severe strain of stem pitting have readily observed symptoms in the form of growth and in the leaves and fruit.

Cassia siamea.—A mildew *Oidium* sp., was observed on tress in the Mbulu District. Although trees suffered a severe set-back through death of twigs subsequent twig growth was healthy.

Coffee.—Attention has been given to rots which arise when stems are cut back and when woody branches are pruned. Such rots are undoubtedly seriously affecting a very considerable proportion of the older coffee trees in the territory and thus reducing crop. The subject is still under investigation but a preliminary account was made available to coffee growers in Mycological Circular No. 32. Briefly control measures are to paint cut surfaces to prevent infection and to

renew the paint at intervals; also where there is a stub of stem between a cut and a multiple stem the stub should be kept alive by a lung-branch which may suitably be a lower branch of the original stem. Fungi isolated from rotted tissue below pruning and stumping wounds are: *Fusarium stilboides* and an unidentified *Phoma* sp. From a "Punky heart" form of the rot there were isolated *Trichoderma viride* and a sterile white fungus probably a species of the Polyporaceae.

Bark disease which was originally described in 1932 by Dr. H. H. Storey of the East African Agricultural Research Institute, Amani, in Usambara coffee plantations appears to be increasing in intensity and extending its range. At the time of preparing this report the disease is known to be widespread in the West Usambaras and less common on Kilimanjaro and it is clearly a cause of considerable damage to trees and of reduced crop. The symptoms of bark disease when not confused by other diseases and pests can be very distinct.

A disease known provisionally as "Scaly bark" is common in the Usambaras and on Kilimanjaro. The possibility that this may prove to be a form of bark disease is being investigated.

A form of die-back was seen in one clone of young coffee plants. It was confined to the upper twigs exposed to strong sunshine. *A Colletotrichum* sp. and an undescribed species of Phomopsis was isolated from the affected twigs; it appeared to have entered at dead flowers.

Rust, *Hemileia vastatrix*, was so abundant late in the year that it was possible to make observations on the relative susceptibility of some varieties and clones of Arabica on the Coffee Research Station. Mr. L. M. Fernie, Horticulturist, has noted varieties which appear to have a considerable degree of resistance to rust and he plans to cross these with clones having other useful qualities. The degrees of susceptibility in clones will be studied in relation to yield.

Eucalyptus.—A nursery of *Eucalyptus cladocalyx* at Kisarawe had heavy losses in seedlings soon after germination and there were further losses after transplanting into pots. A common fungus, *Glomerella cingulata*, which normally causes leaf-spotting of many plants—fruit-trees, vegetables and flowering plants—was fruiting abundantly on the leaves and stems. This fungus was obtained in pure culture and used for infecting eucalyptus seedlings in the laboratory. The symptoms shown by the Kisarawe plants were reproduced. Moist conditions encouraged infection. Affected seedlings and transplants show a curling and mottling of the leaves and eventually die. Spraying with Bordeaux mixture was recommended and was found effective in keeping seedlings healthy in fresh sowings. Other precautions were to sow on a fresh seed-bed watered with Cheshunt compound and to treat the seed with a fungicidal seed-dressing.

Groundnut.—The Provincial Agricultural Officer, Tabora, recorded serious Rosette infection at several areas in the Western Province while in the Central Province it was stated by the Agricultural Officer, Dodoma, to be fairly serious in the main groundnut areas of north Singida.

Hibiscus.—Rust, *Aecidium garckeanum*, was found on several species of Hibiscus by Mr. J. Hemingway, Plant Pathologist of the Overseas Food Corporation, Nachingwea.

Lettuce.—The virus disease Mosaic was seen in the territory for the first time. The identification is based on symptoms only: these are mottling of the leaves, vein-clearing, numerous minute brown spots and marginal browning on the leaves, leaf-distortion, non-hearting and bolting to form small flowering heads.

Control measures advised are to take seed from a healthy crop and in endemic areas to sow away from other lettuce. Infected plants should be taken up; systemic insecticides might be used, with guidance from an entomologist for the control of the aphid vectors; other host plants such as sweet pea, field pea and the weed sow-thistle should be watched for symptoms and in any case they should not be allowed to grow near lettuce.

Lima Bean.—A pod rot resulted from the presence of *Botrytis cinerea*.

Lupin.—Two species of lupin, *Lupinus luteus* and *L. hirsutus* have shown a rot of stems and roots resulting in wilting of the plants. Stem rot was caused by *Fusarium oxysporum*, while *F. solani* was isolated from roots and was found capable of killing seedlings of garden lupins in the laboratory. The identity of the two species was confirmed by Dr. W. L. Gordon.

Maize.—A disease new to East Africa is Brown spot, *Physoderma maydis*, which was found near Moshi in July. It has been described in the *East African Agricultural Journal*, October, 1953. Fortunately it has not so far been seen doing much damage. It is necessary to distinguish this disease from Polysora rust.

Polysora rust (*Puccinia polysora*) has been seen during the year in the three coastal provinces and at Moshi in the Northern Province. It was most damaging in the former.

Pink ear-rot fungi, *Fusarium* spp., have been found entering ears damaged by birds and tunnelled by caterpillars so that the control of these pests must be added to the other control measures for the ear-rot fungi.

Ocotea usambarensis.—Fructifications of *Fomes senex* have been identified on this tree: the tree was old and hollow but the significance of the fungus is uncertain. It had previously been recorded during the German occupation.

Papaw.—Two cases of virus disease of the Mosaic type have been seen. Root rots were caused by *Pythium ultimum* and *P. vexans;* the identification of the latter was confirmed by Dr. V. A. Wager.

An unrecorded scab disease was found in one field near Moshi. It is caused by a new species of Sphaceloma, which is being described in a separate publication. The disease appeared to be associated with high humidity. All the plants in the affected plantation were under six months old.

Pea.—There have been no records of the bacterial blight, *Pseudomonas pisi*, during the year.

Persian lilac (*Melia azadarach*) frequently shows much defoliation by a leaf-spotting fungus, *Septoria meliae*.

Petrea.—Leaf-spots have been seen caused by *Glomerella cingulata* and a *Cercospora* sp.

Petunia.—A wilt was associated with *Fusarium solani.*

Pinus radiata.—Cylindrocarpon radicicola was isolated from roots of a two-year-old tree from Mufindi. This is a known pathogen of pine seedlings and of other plants. Death of the Mufindi plants may however have been caused in part by some unfavourable local conditions.

Pomegranate.—Leaf-spots resulted from *Cercospora punicae.*

Potato.—A further twelve varieties were received by the agricultural officer, Lushoto, from Dr. Black, Corstorphine; nine were reputed blight resistant and three leaf roll resistant. These were planted at Kungului farm, Lushoto. Two of these varieties, 409b(39) and 1943de(1) proved susceptible to blight but the former had been imported for leaf roll resistance.

The varieties 1521c(3) and 1564a(14) introduced four years ago have continued to show blight resistance and new lots have been imported to the Northern Province for multiplication.

Sorghum.—A saprophytic species of bacteria, *Bacterium lathyri*, was isolated from leaf-spots the primary cause of which was thought to be *Cercospora sorghi.*

Tobacco.—Foot-rot of seedling tobacco at Tunduru was caused by *Macrophomina phaseoli.* Improved drainage and avoidance of overcrowding were recommended.

Tomato.—Blight, *Phytophthora infestans*, was very prevalent and destructive in the Northern Province at least. In a trial the disease was successfully controlled by seven applications of Perenox; untreated plants were a failure.

A fruit rot resulted from *Sphaeronaema lycopersici.* Grey mould of fruits was *Botrytis cinerea.*

Wheat.—Owing perhaps to the exceptionally dry season rust diseases were not a major problem in 1953. Leaf rust, *P. triticina*, and yellow rust, *P. glumarum*, were not even seen by the Senior Research Officer (Plant Breeding) Kenya, in a tour he made in the Northern Province. Stem rust, *P. graminis*, was rare and appeared too late in the season to have any detrimental effect on yields. Only four samples of stem rust were received at the laboratory for determination of the physiological forms present—these were K1, K9 and possibly K11.

The increasing occurrence of foot rots of wheat caused by *Helminthosporium sativum* and *Fusarium graminearum* in all areas where the crop is grown suggests that seed treatment with an organo-mercurial dressing should be a routine practice on farms.

Wheat grains from the Southern Highlands Province with a distinct pink colour were found to be infected with the fungus *Acremoniella verrucosa* and not as was suspected with Fusarium. The fungus did not impair germination and was completely suppressed by an organo-mercurial seed dressing.

Mechanical Equipment

The only machinery on hand at the plant pathology laboratories is one Dronwal knapsack sprayer.

Fungi, etc., New to Tanganyika

Apple	*Rosellinia necatrix* Prill.
Banana	*Cephalosporium* taxonomic sp. 2 in C.M.I. Culture Collection.
Banana	*Zygosporium oscheoides* Mont.
Barberton daisy	*Verticillium albo-atrum* Reinke & Berth.
Cashew nut	*Aspergillus chevalieri* (Mangin) Thom & Church.
Cassia siamea	*Oidium* sp.
Castor	*Bacterium lathyri* (Manns & Taubenhaus) Dowson.
Castor	*Pseudomonas ?aleuritidis* (McCulloch & Demaree) Stapp.
Cenchrus ciliaris	*Sorosporium penniseti* Mundkur.
Citrus	Stem pitting strain of Tristeza virus.
Coffee	*Fusarium stilboides* Wollenw.
Coffee	*Phoma* sp. undescribed.
Coffee	*Phomopsis* sp. undescribed.
Coffee	*Trichoderma viride* Pers. ex Fr.
Coffee	*Verticillium* sp.
Hibiscus spp.	*Aecidium garckeanum* P. Henn.
Lettuce	Mosaic virus.
Lucerne	*Rosellinia necatrix* Prill.
Maize	*Physoderma maydis* Miyabe.
Melia azadarach	*Septoria meliae* Syd.
Ocotea usambarensis	*Fomes senex* (Nees ex Mont.) Sacc.
Papaw	*Pythium vexans* de Bary.
Papaw	*Sphaceloma* sp.
Petrea	*Cercospora* sp.
Pomegranate	*Cercospora punicae* P. Henn.
Pinus radiata	*Cylindrocarpon radicicola* Wollenw.
Pine	*Diplodia pinea* (Desm.) Kickx.
Quinine	*Pestalotiopsis guepini* (Desm.) Steyaert.
Sorghum	*Bacterium lathyri* (Manns & Taubenhaus) Dowson.
Tomato	*Sphaeronaema lycopersici* Plowr.
Wheat	*Acremoniella verrucosa* Tognini.

New Hosts for Pathogens Already Recorded in Tanganyika

Bean, Bonavist (*D. lablab*)	*Uromyces vignae* Barcl.
Bean, French	*Botrytis cinerea* Pers. ex Fr.
Bean, Lima	*Botrytis cinerea*
Begonia	*Glomerella cingulata* (Stonem.) Spauld. & Schrenk.
Candytuft	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.
Cashew nut	*Aspergillus niger* van Tiegh.
Cashew nut	*Botrydiplodia theobromae* Pat.
Cashew nut	*Cephaleuros mycoidea* G. Karst.
Cashew nut	*Glomerella cingulata.*
Cashew nut	*Nematospora coryli* Pegl.
Citrus	*Fusarium solani* (Mart.) Sacc.
Lupin	*Fusarium oxysporum* Fr.
Lupin	*F. solani.*
Melon	*Mycosphaerella citrullina* (C.O. Smith) Grossenb.
Papaw	*Glomerella cingulata.*
Papaw	*Pythium ultimum* Trow.
Petrea	*Glomerella cingulata.*
Plum	*Armillaria mellea* (Fr.) Quél.
Quinine	*Glomerella cingulata.*
Rice	*Fusarium moniliforme* Sheldon.
Sugar cane	*Fusarium moniliforme.*
Tobacco	*Macrophomina phaseoli* (Maubl.) Ashby.
Tomato	*Botrytis cinerea.*
Wheat	*Nigrospora oryzae* (Berk. & Br.) Petch.

G. B. Wallace,
Plant Pathologist

ANNUAL REPORT OF THE BOTANIST FOR THE SEASON 1952–1953

General

The season was a difficult one: the rainfall was low (18.76 inches between October 15th, 1952 and May 26th, 1953) and distribution was bad during the early part of the season. The behaviour of the short-term sorghums under these conditions was most encouraging. Much of the early planted material gave very good heads and well filled grain on an ill-distributed seven inches of rain, a striking demonstration of the value of early maturing sorghums.

Central Shoot Fly attack was very light on late plantings, so that it was possible to take two crops of some of the early sorghums.

A. Sorghum Breeding

Details of the breeding programme have been given in previous reports. Early maturing sorghum varieties are required with the following characters: palatable weevil and moth resistant grains: large grains: bird resistance: grain mould resistance: smut resistance: striga resistance.

Weevil resistance:—Crosses between B.C.27 (three and half months, poor storer) and Wiru (five to six months, weevil resistant grain) have been continued. The best selection from the first cross, at present known as BCWK3, was bulked. It matured in some three and half months, the plants were very vigorous and healthy and storage tests showed the grain to be as weevil resistant as Wiru. The heads were poor and yield light. It has shown that a high degree of weevil resistance can be coupled with earliness of maturity and vigour of growth but much better yield is required.

Progress was made with the first backcross (B.C.27) 2 × Wiru: more than 100 good plants with apparently useful grains were selected from the F_2 generation and gave some good progeny rows in the F_3. The heads with the best grains were selected individually and not put into storage tests but tests on the remaining bulk F_3 material showed that only about ten per cent of these had an acceptable level of weevil resistance. The panicle weight was a considerable advance on that of the BCWK3 mentioned above. A useful combination of yield and weevil resistance is expected in the F_4 generation which has been planted. The F_1 from the first backcross (B.C.27), 2 × Wiru, repeated from the best grained early segregates of the first cross B.C.27 × Wiru, was grown and a large F_2 generation has been planted.

The second backcross (B.C.27) 3 × Wiru was made and the F_1 generation grown: a large F_2 planting has been put in. This should have carried backcrossing far enough (in the B.C.27 × Wiru) but the weevil resistant segregates will need to be carried on for several generations before any will be ready to bulk.

In the Dobbs × Wiru crosses early weevil resistant segregates had very poor heads. The best of these were backcrossed to Dobbs and the F^1 generation grown out in the greenhouse.

The same was true of the segregates from the B.C. × Msumbiji cross; the best of these were crossed back to B.C.27 and the F_1 generation grown out.

The F_1 generation of (B.C.27) 2 × Belko was grown and a large F_2 generation has been planted. Msumbiji and Belko have been included in the programme as they appear to be resistant to grain moulds as well as being weevil resistant. Now that a greenhouse is available it should be possible to make a more accurate assessment of grain mould resistance.

Some attention is also being given to crosses with Nokwe and Ushiriki which have an exceptional degree of weevil resistance and also appear to be resistant to grain moth. Work on these will be intensified when the bird resistance problem has been more fully explored.

Bird resistance:— Without doubt bird damage is the major hazard of the sorghum grower. A large part of the damage is done by the Dioch (*Quelea quelea*) although in areas where there is a lot of bush and tree cover available (as at Ukiriguru) the Grey Headed Sparrow (*Passer griseus*) and the Masked Weaver (*Ploceus intermedia*) can be very destructive. The following table records catches of bird taken in basket traps baited with millet from February to December 1953 at Ukiriguru.

TABLE I

Month	*Dioch*	*Sparrow*	
February	5	Nil	
March	129	1	
April	Nil	1	
May	Nil	Nil	
June	1	Nil	Numbers likely to be an under-estimate, as plenty of grain was available in the field.
July	28	Nil	
August	25	Nil	
September	7	Nil	
October	Nil	Nil	
November	28	Nil	
December	32	24	

Masked Weaver birds seldom enter these traps. Trapping will have to be continued for some years before any idea of the seasonal fluctuations of the Dioch in particular can be obtained.

There can be no certainty of obtaining bird resistance without recourse to a bitter grain: all that can be said at present is that certain characters do seem to limit the amount of bird damage. An inverted head (goose-neck) suffers less bird damage than the erect type, at least half the grain escaping. An awn is of some slight value and the possibility that a very large glume completely enveloping the grain may be of use is being examined. The aim is to obtain all these characters together in the one plant.

The crosses B.C.27 × Ng'holongo, (tall, six months, good storer) and Oklahoma 44/14 (early American combine type) × Ng'holongo gave some useful early maturing plants with goosenecks. The F_2 generations of the first backcrosses (B.C.27) 2 × Ng'holongo, and (Oklahoma 44/14) 2 × Ng'holongo have been planted. Other useful goose-necks were obtained from B.C.27 × Korgi, (large grain, five months), (B.C.27) 2 × Korgi, Oklahoma 44/14 × Korgi, and (Oklahoma 44/14) 2 × Korgi. Some of the Korgi crosses gave a good awn in addition to the goose-neck.

Good awns have been obtained from B.C.27 × Nandayal Boona, together with close but well ventilated panicles due to a very stiff seed branch. The F_2 generation of the first back-cross has been planted.

A sorghum, Feki Mustahi, was received from the Sudan through the kindness of Dr. Bunting. It has very large glumes indeed and it was hoped that it might be bird resistant: in fact birds strip it completely. The grain is large and projects from the sides of the glumes and it is here that the birds attack it there being no signs of the glumes being torn open. Since it is easy to obtain sorghum varieties with large grains in small glumes there seems no reason why it should be difficult to obtain small grains in large glumes and Feki Mustahi has been used as a parent to this end.

Large grain.—This character is in the programme as a "selling point" since it is so popular with the people as it can be handled like maize in preparing food. It is a drawback where bird resistance is concerned but there is reason to believe that in areas where bird attack is not severe its advantages will outweigh the disadvantages. The large grain is being transferred from Korgi onto early parents and grains of a satisfactory size are being obtained from the first and second backcrosses of B.C. 27 and Oklahoma 44/14 with Korgi. Good goose-necks and awns are also coming out in these crosses.

Combination of Characters.—Over 100 crosses were made between F_3 plants of the (B.C.27) 2 × Wiru, with various good plants from Ng'holongo and Korgi crosses. This was exploratory to see how the coupling of goose-neck, good awn, and weevil resistant grain would proceed. At the time of writing it appears to have been worth doing: some good goose-necks and awns have been obtained and some of the grains from (B.C.27) 2 × Wiru by B.C.27 × Ng'holongo have a better corneous layer (closely associated with weevil resistance) than any of the parents. It remains to be seen how they segregate.

General Comments on the Crossing Programme.—The above account gives the impression of a plethora of crosses but the need for obtaining weevil and bird resistant early sorghums as rapidly as possible justified the means used. It seems clear that crossing has been carried far enough to obtain useful early weevil resistant types and conventional progeny row breeding should yield good new varieties with these characters in two to three years' time and moderate ones fairly soon.

Efforts are now concentrated on obtaining bird resistance and many exploratory crosses are necessary. Few crosses are followed out exhaustively. Some good material is taken from each and the remainder goes into storage as open-pollinated bulks from which selections can be made from time to time. The handling of so much material in this way would be impossible without the intelligent co-operation and useful work of the African recorder staff who make all the crosses, do all the selfing, and a good deal of the initial selection in segregating material in the field.

Striga.—Selection is being continued within Dobbs for a greater degree of striga resistance. There was very little striga this season so selection was difficult and the same progeny rows will be planted next year. Striga counts in the district plots are given in the next section (Experimental).

Reference collection.—The number of varieties maintained by self pollination was reduced to 150 and the remainder put into two open pollinated bulks, one for early varieties and the other for late maturing types. A large number of new varieties has been received, the bulk of them from French Equatorial Africa.

B. Experimental

Storage tests.—Storage tests were done on seventy-two sorghum varieties in six replications together with layer thickness measurements. Density estimations are not yet completed and the Government Chemist is kindly doing moisture and nitrogen contents of the grain. The regression of storage on layer thickness was $b = -1.467 + .287$, giving $t = 5.11$, whereas a value of 3.46 is required for significance at $P = .001$. This is satisfactory evidence that the thickness of the corneous layer in the endosperm is sufficiently well associated with weevil resistance to be a reliable character in selecting for such resistance.

The usual routine storage tests on breeding material were also done.

Variety trial.—The results of the district plot variety trials are given below. Ng'holongo has yielded poorly for three seasons owing to its length of maturity and was replaced by B.C.27 while Oklahoma 44/14 was put in instead of P.41.

District Plot Variety Trials. Yields in Lb. Acre

Plot	B. Mahemba	Dobbs	B.C. 27	Oklahoma 44/14	Sign. Diff. (.05)
Mabuki	675	810	925	140	135
Kitunga	150	705	450	325	125
Lubaga	480	1,985	1,710	1,075	245
Butulwa	505	1,930	1,220	505	205
Mean over 11 plots	450	1,330	1,075	510	

It will be noticed that the mean yield of Dobbs over the four plots is well above the average of 950 lb. for the previous three seasons. It is generally agreed that last season was a difficult one but there is good reason to suppose that given the right early maturing sorghum there could have been a sufficiency of grain in the Lake Province.

Striga trials.—Counts of striga plants pulled in the district plot trials are given below:—

Striga Counts. Striga Plants per Acre

Plot	B. Mahemba	Dobbs	B.C. 27	Oklahoma 44/14
Mabuki	2,170	50	10	0
Kitunga	1,300	95	10	1,500
Lubaga	7,230	615	990	9,200
Butulwa	315	180	350	690

Only the Lubaga figures were worth analysing and these showed that Dobbs has significantly fewer striga plants than the other three varieties at $P = \cdot 05$ and Dobbs $\times$ B.C.27 had fewer than the remaining two varieties at $P = \cdot 01$. These counts are very much lower than in a normal season.

The striga counts on the various rotation trials at Lubaga were very irregular and no definite conclusions could be drawn from them. The figures suggest that two years of cotton reduce the amount of striga in a subsequent sorghum crop compared with continuous sorghum.

The striga rotation trial at Ukiriguru was under its first year of rotation crops having been under sorghum in previous seasons to build up a good reservoir of striga seed on the land.

C. Other Crops

The usual reference collection of legumes and early bulrush millet types was grown. Some early millets from West Africa grew well and have an unusually large grain which unfortunately does not store very well, being large enough for grain moth and weevil to develop inside. The groundnuts were a complete failure.

D. Rice

General.—It was a good season for irrigated rice although one small hail-storm when some of the rice was almost ripe caused loss of grain. More labour was available than usual and it was possible to start transplanting on February 2nd.

The new pump has at last been installed and the well at the end of the main furrow from the lake has been stone lined. The water supply is now very satisfactory.

Selection.—The objects are to obtain rices with a stronger straw and less shedding than Kahogo (the present standard variety) without loss of grain quality. A large number of selections had accumulated (owing to the botanist's absence on leave the previous season) and attention was given to sorting these. Nearly 1,000 re-selections from the previous two seasons were grown out in progeny rows and 153 were retained for further study. No fresh selections were made.

Experimental.—Promising selections from the 1950 and 1951 seasons were put into a 169 variety quadruple lattice and the 1949 selections which had previously been through a large trial were tested in a twenty-five variety balanced lattice.

The 169 variety lattice served its purpose admirably but smaller trials are somewhat easier to handle in the field and will be used in future. The yields in this trial were good, the replications occupied about a half-acre each and yielded as follows:—

Replication	*Yield (lb./acre)*
I	2,690
II	3,300
III	4,260
IV	2,380

There were substantial differences in yield between varieties as the following table shows:—

Summary of 169 Variety Quadruple Lattice

Yield class, lb./acre	Number in class
Over 5,000	1
4,500—5,000	3
4,000—4,500	14
3,500—4,000	39
3,000—3,500	40
2,500—3,000	46
2,000—2,500	14
below 2,000	12

Mean yield of Kahogo, 3,390 lb./acre. Significant difference (.05) 790 lb./acre.

Sixty-four of these varieties were retained for re-trial the following season: twenty-eight were assessed as shedding less and having a stronger straw than Kahogo and thirteen of the twenty-eight had a grain quality as good as or better than Kahogo.

Yields in the twenty-five variety trial were lower owing to a hail-storm: it was almost ready for harvest at the time and grain loss was appreciable. (The rice in the 169 variety trial was still very immature and little grain was lost).

Summary of 25 Variety Trial

Yield (lb./acre)	Number	*A* Better straw than Kahogo	*B* Non-shedding	Both characters A & B	*C* Quality as good as, or better than Kahogo	All three characters, A+B+C
2,500–3,000	4	0	0	0	4	0
2,000–2,500	18	3	8	2	8	1
1,500–2,000	2	1	0	0	1	0
	24	4	8	2	13	1

Kahogo control yield 2,385 lb./acre. Significant difference (.05) 215 lb./acre.

The varieties in this trial were all 1949 selections and while grain quality was good few had satisfactory straw stength. Nine varieties were retained for further trial but the 1950 and 1951 selections appear to contain more promising material than the 1949 selections.

Future work.—Selections made in 1949-1952 will be sorted down to a few of the best to be tried out in the Lake Province and elsewhere in the territory and further selection work will have to be suspended until this has been done. There is some reason to question whether there is sufficient straw strength in the Mwabagole material for the development of an entirely satisfactory combine type. The Field Officer, Lupiro, has reported a variety Namilambo with an unusually thick and strong straw, and this is being added to the Mwabagole material for study.

E. Acknowledgments

Helpful information has been received from many members of the department during the year, and the Empire Cotton Growing Corporation staff at Ukiriguru have assisted greatly with advice and general interest in the work. The Field Officer, Ukiriguru, has made an excellent job of the pumping installations at Mwabagole, and the Arab overseer there has brought the working of that station to a much higher level of efficiency.

H. Doggett,
Botanist

ANNUAL REPORT OF THE FISHERIES OFFICER (INLAND FISHERIES) FOR THE YEAR 1953

Mr. G. J. Lockley, Fisheries Officer, was in charge of the inland fisheries (other than fish farming) throughout the year. The Asian Grade I Junior Service clerk resigned in January and was replaced by an African Grade III clerk in March. There have been no other additions to or changes of staff at the Kigoma headquarters.

A series of three concrete tanks have been built at Kigoma for accumulating and holding stocks of fish from Lake Tanganyika which might be required for stocking elsewhere. Electricity was installed at the Kigoma office this year.

M.F.V. *Sangala*, after being on the slipway in January for routine underwater care and maintenance was in continuous use until December when it became necessary to lay her up for re-decking as the existing deck was damaged by fungal rotting. The timber elsewhere in the hull gave some concern but with speedy remedial measures there has been no cause for alarm regarding *Sangala's* seaworthiness. However it should be recorded that experience here and on Lake Victoria has shown that wooden hulled vessels are subject to rapid deterioration in lake water particularly if the timber is not of the highest quality.

The Provincial Administration M.V. *Imara* was finally written off in March and subsequently *Sangala* has been the only Government vessel in service on Lake Tanganyika. As a result, in addition to her normal fisheries duties she has carried other Government passengers and was of particular use in enabling the Medical Department to deal rapidly and effectively with outbreaks of sleeping sickness and smallpox which occurred at lakeside fishing villages during the year.

His Excellency the Acting Governor inspected the station in July and undertook a short cruise in *Sangala*. A similar trip was made by His Honour the Chief Justice in October.

Mr. R. Ross of the Department of Botany, British Museum (Natural History), spent a week in January working from Kigoma. The main object of his visit was to investigate the diatom flora of Lake Tanganyika (diatoms are an important item of fish food). He was able to complete a number of deep-dredging and tow-net operations from *Sangala* and a large number of samples were secured. In addition he made a useful collection of water-plants required by various botanists working on the *Flora of Tropical East Africa*.

The Fisheries Officer represented the territory on the East African Inland Fisheries Research Advisory Committee during the year. In June he attended a meeting of Provincial Natural Resources Officers with the Royal Commission on Land and Population.

Advisory work has played a large part in the year's activities. In particular there has been a considerable increase in correspondence with manufacturers and importers of fishing gear who are showing an increasing interest in potential markets on inland waters other than Lake Victoria which has hitherto absorbed the bulk of all imports of fishing gear.

Lake Tanganyika

This has been only a moderate year for the Lake Tanganyika dagaa fishery which has been particularly unfortunate in the weather experienced. High winds tended to keep the shoals away from the shore during the dry season and often stormy weather has coincided with those dark periods of the moon when the fishery takes place. The peak fishing period of November–December in the Kigoma area was marked by abundant shoals of fish and reasonable fishing weather but unfortunately exceptionally frequent and prolonged rain seriously hindered the sun-drying of the catch.

This year has also been marked by a certain slackening in demand for dried dagaa with a consequent tendency for the price to fall on territorial markets. The main purchasers of the product are employers of fed labour, principally sisal estates. The fall in the price of certain estate crops leading to a reduction in labour strength and a more cautious policy in the purchase of rations was soon felt by the dagaa industry. There were also signs of a weakening of the market for our dried dagaa in the Belgian territories which may in part be due to the considerable efforts that the Belgian authorities are now making to encourage dagaa fishing in their own waters. The dagaa industry expanded greatly to meet the needs of the war and the post-war boom period. Its potential output is considerably greater than has been achieved but it is considered likely that unless some completely new market is found the output will remain particularly sensitive to the demand for labour rations. It is emphasized that for many natives dagaa fishing is not a full-time occupation and many are only attracted to it in times of great demand with consequent high prices. The industry in its present form is very flexible and is able to adjust itself to demand without any undue hardship or loss of capital to the primary producers.

The amount of dried dagaa, 1042 tons, recorded as passing through Kigoma for export (see Appendix A) is less than for the past few years (1952—1185 tons, 1951—1213 tons, 1950—1663 tons). Whilst to a certain extent this reflects the situation outlined in the foregoing two paragraphs there has been an increasing tendency to market dagaa other than through the Kigoma wholesalers, e.g., sixty tons are known to have been railed from Mpanda and there have been many small direct sales by natives to Belgian territories and to Northern Rhodesia. The imposition of a Native Authority Cess on dried dagaa in the three producing Districts of Kigoma, Mpanda and Ufipa has undoubtedly led to evasion by export via clandestine routes, but a tightening up of the machinery for collection should do much to give a more accurate picture of output. It is estimated that the total overall annual production of dried dagaa was not less than 1,300 tons equivalent to 4,000 tons of fresh fish. The 408 tons exported to the Congo were valued at £37,805 for Customs.

The demand for fresh fish (of species other than dagaa) has continued to exceed the supply in the Kigoma–Ujiji area. There has been a noteworthy effort by an African fisherman with a canoe powered by outboard engine to supply this market from fishing grounds further afield. In general the bulk of fish caught away from the immediate area of Kigoma–Ujiji is offered for sale as smoked fish. This has been in more bountiful supply this year and has found a ready sale both locally and in the hinterland of Uha. There has been a small export of smoked fish to the Congo of forty tons valued at £4,270.

Throughout the year experimental trawling has been carried out from *Sangala* in a variety of situations. The gear in use is a Vigneron-Dahl rig with 33ft. headline, 7 fm. sweeps and 3ft. 6in. × 1ft. 10in. otter boards. *Sangala* has no winch and it was rarely possible to hand-haul the gear effectively from greater depths than twenty fathoms. Within these limitations trawling could not be considered a success. A total of 178 hours towing time in tows of one, one and a half or two hours' duration and excluding tows involving fouled gear yielded a total of only 1,101 lb. of fish (all species including those of no commercial value), an average of 6.3 lb. per hour's fishing time. The best tow, of one and half hours' duration, yielded only thirty-seven and a half lb. of fish. On no occasion were any obvious shoals of bottom fish encountered and generally the catch consisted of a miscellaneous assortment of many species, mainly of a small size and of little commercial interest.

From what is known of the fish fauna of Lake Tanganyika these results were not unexpected. The majority of the bottom-dwelling fish consist mainly of many genera and species of the family Cichlidae, mostly small in size and relatively few in the number of individuals comprising any one species. Those species of fish which occur in considerable numbers in the lake are all pelagic, e.g., dagaa. The rocky nature of much of the Lake Tanganyika shoreline and the presence of tree trunks and submerged vegetable debris on the mud bottoms off the river mouths present a considerable threat to the gear when trawling. The major part of Lake Tanganyika is of such great depth that in any event trawling would only be possible in limited offshore areas.

Trolling with artificial lures and with dead bait has been carried out at intervals throughout the year both from *Sangala* and from a dinghy powered with outboard engine. The three main kinds of predaceous fish which may be caught by trolling: Nile Perch (*Lates* spp.), Yellowbelly (*Boulengerochromis microlepis*) and Tiger Fish (*Hyrdocyon lineatus*), show no evidence of shoaling. Generally speaking they may only be caught off the rocks in sheltered situations such as Edith Bay. For this reason a small boat of shallow draught and great manoeuvrability can be operated with less risk and greater success than a vessel such as *Sangala*. For the same reasons it is not possible to undertake multiple-line trolling with tangons in the areas where fish may be caught.

It is known that the dagaa (*Stolothrissa tanganicae*), which form the staple food of the predaceous fish remain at a depth of sixty to eighty feet during the daylight hours. There is much reason to believe that the predators do little feeding during daylight. Certainly with trolling the best results are always obtained at dawn and dusk. Trolling in the surface waters of the open lake by day proved a blank. "Chumming" with ground-bait and spraying the surface with jets of water, methods which are successfully used to attract and excite feeding fish in the troll fisheries for marine tuna proved to have no effect even when carried out in areas where dagaa were seen being chased by predators near the surface. Attempts at deep trolling by day with heavily weighted lines also proved blank but we had no means of telling at what depth the lines were actually fishing in relation to the trolling speed. Three small Nile perch only have been hooked when trolling at night. The difficulty here is that fish will not take (cannot see ?) an artificial lure by night and dead bait seems equally unattractive. The dagaa are such small and delicate fish that it is virtually impossible to use them as live bait on hooks.

Whilst a few other possibilities remain to be tried (e.g. a lure incorporating some form of light for use at night) it is concluded that trolling offers little prospects as a large-scale commercial method of fishing. Many native fishermen are interested in trolling. There is always a steady demand for lures in Kigoma and the native canoes are particularly suitable for operating off the rocks. As far as is known no natives are trolling on a full-time basis. Generally a few lines are trolled when following closely to the shoreline on long lake passages.

It might be thought that the age-old method of shore seining was not capable of further refinements but a singular advance has been made in this field this year. On Lake Tanganyika many of the species of fish move from deep water towards the shore at night and normally it is only at night that worthwhile hauls come within the range of shore seines. With the knowledge that dagaa are attracted and can be led by light and with the assumption that the dagaa predators would remain close to the dagaa shoals several experiments in the use of lights were carried out with a group of African fishermen owning a large seine net. The method evolved entails the use of a 300 c.p. pressure lamp fitted with a reflector and suspended from a canoe which is taken out to up to two miles from shore. When dagaa or other small fish begin to appear beneath the light the canoe is paddled very slowly shoreward until within range of the seine which is then quietly laid astern of it by another canoe. The lighted canoe remains within the arc of the seine net until it nears the beach in the final stages of hauling. Greatly increased seine catches have been made by this method which has been particularly successful with Nile perch or sangala. Most seine net fishermen in the northern sector of the lake are now using lamps.

Throughout the year regular gill net trials have been undertaken on grounds off the Malagarasi Delta where earlier work had shown that there were frequently high concentrations of fish present. These trials were designed to test the relative efficiency of various types of net and various mesh sizes, the effect of setting the nets at varying distances from the shore and at different depths and to obtain data on the seasonal abundance, breeding, etc., of certain species of fish. Gill nets were also set in a few other areas to test conclusions which had been reached regarding the type of ground on which certain species of fish could be caught.

The gill net is a selective fishing instrument. Only nets of two inch mesh will catch the Spiny Eels (*Mastacembelus* spp.), Mibanga (*Bathybates* spp.) can only be caught in nets of two and half to three inch mesh and Moonfish (*Citharinus gibbosus*) require a mesh of six inches and upwards. Fleets of nets of various size meshes have been set at various depths to obtain an overall sample of the fish population in the area at any given time. A knowledge of what species of fish can be expected in what environment at what time of the year can determine the size of the mesh to be used and how and where the net should be set to obtain the optimum catch. The question of the minimum size mesh to be used to avoid the capture of immature fish of certain species must also be considered. This matter is of great importance where a gill net fishery is primarily directed against one species as for example with the *Tilapia* fisheries of Lake Victoria. Data from our experiments and from a study of native gill net fishing suggests that for Lake Tanganyika there is no need at present to impose any mesh size restrictions. On this lake gill nets of each size mesh catch a wide range of various species of fish and there is no large-scale fishery directed against any one species. Although we lack records concerning any fluctuations in catches of

various species in the past it is probably true to say that the stocks of nearly all species of fish in the lake are underfished. Smaller size meshes will catch immature fish of species of which the adults can be caught in a larger size mesh but the proportion of these is usually small compared with the catch of mature fish of species which can only be caught with the smaller mesh. Several of the smaller species of fish such as *Bathybates* spp. (which are dagaa predators) and *Synodontis* spp. are relatively abundant and it is very desirable that they should be cropped.

The complete absence of the valuable Yellowbelly or Kuhe (*Boulengerochromis microlepis*) from Malagarasi Delta catches suggested that this is a fish of very restricted habitat. Trials in other areas have shown that this fish is a rock-haunting species which may occasionally be caught over sand or gravel bottoms but it does not occur in the turbid waters over mud, mud and sand and mud and shell bottoms characteristic of the river mouth areas. Certain species of fish such as the Elephant snouts (Mormyridae) are very strictly confined to such deltaic habitats and can only be considered as true river species which occasionally stray into the lake. The fish fauna of the affluent rivers and of the lake proper are distinct and different and there is normally very little interchange of species between the two habitats.

Gill nets catch fish which are on the move and our results confirm what has already been shown by other forms of fishing such as seining that there is a general shoreward movement of many species of fish at night and that such movement always appears to be greater during moonless periods. Advantage can be taken of this by laying the nets parallel to the shore particularly off points marking the entrance to bays or inlets.

At present only the standard sizes of manufactured gill nets of flax or cotton which are produced for Lake Victoria viz. two and half inch, three inch and five inch mesh are available for sale in Kigoma. Many Lake Tanganyika fishermen braid their own nets usually from cotton thread. It has been shown that in many instances they are using too heavy a gauge thread. The catching power of the net is greatly increased when a finer gauge thread is used, flax being preferable to cotton. The greatest possibilities however lie in the use of nylon and other synthetic fibres such as terylene. We have experimented with a few nylon nets and found them to be more efficient, more durable and with a longer life than flax nets. Hitherto nylon products have been in very short supply in East African. In the latter half of the year nylon netting twines became freely available in the neighbouring Belgian territories. In spite of its high price compared with flax and cotton many Tanganyika fishermen are now obtaining nylon twine from this source. Nets made from this twine have been very successful and there is now a real demand for its sale in the territory. Supplies from the U.K. are somewhat easier and arrangements have been made for nylon nets and twines to be on sale in Kigoma in the New Year.

It is interesting to note that for Lake Tanganyika the advantage of nylon twine may lie in the fact that a nylon thread of a given gauge has a greater strength than one of comparable gauge in flax rather than in the known resistance of nylon to bacterial rotting, etc. It has been noted here that flax and cotton nets treated with such anti-rot preservatives as Cuprinol or Burma Cutch do not have a much longer life than untreated nets. Deterioration in gill nets seems to be due to

progressive tearing caused by the struggles of captured fish and the unskilful removal of fish from the meshes by the fishermen. It may be of course that the chemical properties of Lake Tanganyika water cause a rapid leaching out of the usual net preservatives.

By their relatively low cost, ease of manufacture, rigging and setting, and the small amount of space that they take up in canoes gill nets offer the best prospect for the expansion of a native fishery for species other than dagaa. There has undoubtedly been a steady increase in the number of gill nets in use by native fishermen over the past year. Our own results are followed with keen interest by many local fishermen and experimental successes have led to the establishment of many native gill netters in the Malagarasi Delta area.

Crocodiles which are one of the main hazards to gill netting elsewhere are fortunately few and far between on Lake Tanganyika. Good prices for crocodile hides this year has led to a certain amount of hunting mainly by Africans and a total of 174 cwt. of Lake Tanganyika crocodile hides were exported from Kigoma during the year.

In the dagaa fishery a very important and significant step forward has been made this year. Experiments designed to find a suitable substitute for the difficult and costly wood fuel illumination ("mwenge") showed that a paraffin pressure lamp of the storm lantern type and of 300 to 350 c.p., fitted with a reflector to direct the light onto the water could give as good as or better results in attracting the fish at a fraction of the cost. A canoe load of "mwenge" (which is the heart wood of "mkurungu"—*Pterocarpus chrysothrix*) costs the fishermen Shs. 30/- to Shs. 50/- per night. The initial cost of the lamp, complete with reflector is around Shs. 120/- and operating costs are less than Sh. 1/- per night for paraffin plus occasional expenditure for spirit, spare mantles, etc.

Experimental successes with the lamp were followed up by an intensive campaign of demonstrations and propaganda amongst the fishermen which was outstandingly successful. Every lamp of a suitable type available in East Africa has been sent to Kigoma and has been immediately sold. There is a large unsatisfied demand which is now awaiting further supplies from the U.K. At the end of the year it was estimated that at least 300 fishermen in the Kigoma–Ujiji area were re-equipped with lamps. There is little doubt that once adequate supplies are forthcoming the major part of the industry will convert to this new method.

Another encouraging sign has been the increasing interest of Tanganyika native fishermen in mechanization. This year three fishermen have equipped their canoes with outboard engines at an average cost of £65 each and several more are now accumulating the necessary funds for the purpose.

The Malagarasi

The Malagarasi swamp fisheries continued to contribute a considerable quantity of smoked fish for territorial consumption and for export to the Congo and to supply Kigoma, Urambo and Tabora with fresh *Tilapia*. As both catching and marketing are undertaken by many small scale native units without being canalized through any central markets it remains virtually impossible to assess accurately the quantity of fish produced from this area.

There have been no new developments on the swamps or river during the year but the European firm at Katare have at last received their freezing plant which is now being installed. Their intention is to freeze *Tilapia* for regular distribution along the Central Line.

The East African Fisheries Research Organization, Jinja, have carried out much work during the year on the material and data secured from the Malagarasi in 1952. Several scientific papers on the fish fauna, breeding habits of *Tilapia*, etc., are now in the Press. The waters of the Malagarasi swamps are crystal clear with remarkably little plankton yet are very productive of fish. It has now been shown that this is largely due to the presence of two species of fish: *Alestes macrophthalmus* and *Distichodus* sp. which feed on water-lily and other plant material. The partially digested mass having passed through their intestines then forms the main food for many other species of fish including the valuable *Tilapia*. The implications of this are of considerable importance as it may be possible to consider the introduction of *Alestes* and *Distichodus* into relatively infertile water-lily swamps such as those of Lake Kyoga, Uganda. The Malagarasi investigations have also discovered the presence of a mollusc-feeding species of fish (*Haplochromis* sp.nov.) which may be of use for introduction into waters carrying the snail hosts of schistosomiasis.

Lake Rukwa

The Rukwa fishery remained open in 1953 although the poor rains of the 1952-1953 season reduced the lake level particularly in North Rukwa where however there is no commercial fishery. It is pertinent to record here that the theory has recently been advanced by the E.A. Fisheries Research Organization that the periodic desiccation of Rukwa may make an important contribution to the high fertility of this lake by the oxidization of the bottom muds during desiccation thus releasing nutrient salts to the water when the lake again floods up.

There are no complete statistics available but the combined efforts of the European licensee and the native fishermen of South Rukwa have yielded a year's catch of at least one million "ngege" (*Tilapia rukwaensis*), approximately equivalent to 300 tons of fresh fish of an estimated value of £10,000. A considerable tonnage of catfish or Kambale (*Clarias mossambicus*) has also been handled but catches of other species were negligible.

When the fisheries officer visited Rukwa in June the *Tilapia* stocks were found to be in healthy condition although some concern was expressed regarding the number of immature fish being landed by native fishermen. Steps were taken to tighten up the enforcement of the size regulations. Wave action and rotting had led to a substantial reduction of the marginal vegetation barrier thus opening up a considerable area of seining beaches with a consequent increase in fishing effort.

Experimental gill netting at the south end of the lake in June revealed the presence of large stocks of several species of fish of economic importance which at present are not being utilized. These included the Butterfish (*Schilbe mystus*), Ningu (*Labeo fuelleborni*), Konje (*Synodontis zambeziensis*), Mtopondi (*Mormyrus longirostris*) and Nkanda (*Gnathonemus macrolepidotus*).

The main troubles besetting the Rukwa fisheries this year have been economic. The European licensee who held the monopoly rights of purchasing all native caught fish offered for sale accumulated considerable surplus stocks of smoked

fish which he was unable to market. He had to reduce and subsequently to suspend his purchases of fresh fish from native fishermen. These difficulties were due in part to the uncompetitive price of Rukwa smoked fish resulting from the high costs of the licensee's overheads and the high cost of road transport to Central Line markets and in part to such factors as a reduction in native purchasing power due to poor harvests and to the greater availability of meat for labour rations in the Southern Highlands Province. The inability of the licensee to excercise his monopoly purchasing rights did not unduly affect the local fishermen who were permitted to sell their catches to native hawkers who peddle the fish in sun-dried form throughout the surrounding countryside.

Questions of licensing, marketing, etc., are under the control of the Lake Rukwa Fisheries Board. The terms under which the licensee operates, the appointment of a marketing agent and other matters of re-organization are now under consideration by the board. Much of the former prosperity of the Rukwa fisheries depended upon a large nearby market with the Lupa goldfields. This market no longer exists and it must be realised that in the present stage of development of the territory the isolation of Lake Rukwa coupled with rising transport and other costs with which the price of fish does not keep pace is not likely to lead to the full exploitation of the resources of this lake for some time to come.

Other Waters

In August a preliminary survey of the Kilombero River fisheries in Ulanga District, Eastern Province, was undertaken. The Kilombero appears to carry abundant stocks of fish of many species. The existing native fisheries have an annual output of approximately half a million fish (all species). Most of the fish is hot-smoked for export and it commands a ready sale elsewhere in the province, particularly in Kilosa and Morogoro. Judging by the fish stocks these fisheries would be capable of considerable expansion but this would be limited by the extensive flooding to which this river is subject at present which makes fishing difficult if not impossible for three to four months of the year; by the considerable number of crocodiles which inhibit the use of such gear as gill nets; by the fact that much of the river lies within a game reserve and by the elaborate and jealously guarded system of native fishing rights at present in force.

Most of the families of African freshwater fishes are represented in the Kilombero fauna and whilst the same species are not necessarily present the composition of their fish fauna shows a striking resemblance to that of the Malagarasi. Hitherto attention has been mainly focused on the fish resources of the rift lakes but it is evident that in some of the main perennial river systems the territory possesses considerable reserves of fish supplies which would repay closer investigation.

Investigations of minor waters have been confined to various small rivers and "lakes" lying within the Lake Tanganyika drainage area of the Western Province. These have included Lake Lugoye in Kasulu District, a small stretch of water containing a population of *Tilapia nilotica* which it is almost impossible to fish owing to the great density of water lilies. This water is considered a very suitable area for the experimental introduction of the water-lily eating fish mentioned previously.

Kitosha, a pan or natural pond on an impermeable bottom of some fifteen acres extent in Kigoma District, was found to be barren of fish life and has been experimentally stocked with *Tilapia melanopleura* obtained from Korogwe. Stocks of this species ex-Korogwe have also been introduced into artificial ponds at Kasulu.

G. J. Lockley,
Fisheries Officer (Inland)

ANNUAL REPORT OF THE FISHERIES OFFICER (FISH FARMING) FOR THE YEAR 1953

Korogwe Experimental Station

During the year two additional ponds were constructed, one of two acres and the other of four acres. The former was made to gain precise information as to cost of construction. It was found however that the conformation of the ground did not allow a pond to be made of the standard depth without very considerable excavation but the rich vegetation made the site very promising and the pond was accordingly constructed although figures for costing would not be comparable to those of a standard pond. The pond has cropped twice and has full justified itself with good yields of well grown fish.

The four acre pond was made with the object of ascertaining whether a larger pond would yield larger fish. Statistics are not yet available on this subject and it is hoped that information will be obtainable early in the new year. The fisheries adviser suggested that experiments could be carried out to crop by netting but the uneven bottom does not make this possible. Very good yields of fish resulted from the first croppings but the fact that this pond controls the outlets of all the other production ponds necessitates that the latter should all be cropped almost simultaneously.

Rice and Fish Experiments

The rice and fish experiments have been continued using the same three ponds each of three-quarters of an acre. Rice was planted at two foot spacing using a local species from the Usambaras. *Tilapia melanopleura* fingerlings were used for the experiment, 1,000 being introduced into Ponds 3 and 4 when the rice was eighteen inches high.

The following table summarizes results:

	Pond 2	Pond 3	Pond 4
Acreage	.75	.75	.76
Planted with Rice Seedlings	3/1/53	5/1/53	—
Stocked with T. melanopleura	—	3/2/53	2/2/53
Rice harvest completed	3/5/53	3/5/53	—
Fish harvest completed	—	6/5/53	4/5/53
Yield of rice	691 lb.	828 lb.	—
Yield of fish	—	171 lb.	142 lb.
Yield of rice per acre	921 lb.	1,104 lb.	—
Yield of fish per acre per three months	—	225 lb.	186 lb.

During the early part of the experiment a severe drought was in progress and at times it was difficult to maintain an adequate water level in the ponds. This with the wider spacing probably accounts for the lower rice yield but it is considered on the whole that the results show great promise.

Later in the year the experiment was repeated using the same species of rice but using *T. nilotica* as well as *T. melanopleura*. The ponds were also changed over from the previous experiment and will be ready for harvesting early in the new year.

Extension Work

The rapid construction of ponds in all parts of the territory necessitates the employment of a second fisheries officer for fish farming. Mr. D. J. Watson was appointed to this post.

Training of Africans continues and a short course for eight agricultural instructors from the Western Province proved a great success. They spent two months at Korogwe and showed considerable intelligence in acquiring the elementary principles of fish farming which will be most useful to them as an asset to their normal agricultural duties.

Long safaris during the year have been made to the Southern Province, Western and Lake Provinces, Eastern and Central Provinces as well as Tanga and Northern Provinces.

It was decided that the second fisheries officer should be normally resident at the Experimental Station at Korogwe to be in close contact with his work and accordingly a temporary European quarter has been built there for him. Construction of this house is now completed and will be occupied by Mr. E. H. O. Martin, Fisheries Officer, who has replaced Mr. Watson.

Fry have been sent from Korogwe for stocking purposes to all parts of the territory by road, rail, air and sea, the species *T. melanopleura* being most generally sent. This species being herbivorous is particularly suited for operation of ponds by Africans as the technique of plankton cultivation then becomes of lesser importance.

Arrangements have been made to import a new species *T. mossambica* from Southern Rhodesia. The fisheries adviser recommends that this species is suitable for use at high altitudes where the growth of other species is rather slow.

In addition to distribution throughout the territory consignments of *T. melanopleura* have been sent to Kenya and Mauritius while assistance has also been given to Northern Rhodesia, Gambia, Gold Coast and Israel.

External Assistance

Great help has been received from the director and scientific staff of the East African Fisheries Research Organization, Jinja, Uganda, particularly in the Lake Province which is adjacent to Uganda and very remote from Korogwe. Long term experiments under their direction are being carried out at Malya with species indigenous to Lake Victoria.

The Fisheries Adviser to the Secretary of State has kept in close touch with developments in the territory and his advice has been of great assistance.

The Director of Agriculture twice visited Korogwe during the year and other visitors included numerous European and African officials from all parts of the territory.

Production at Korogwe

The year has produced most remarkable weather conditions at Korogwe, rainfall having been very heavy for nearly ten months. This has made work at the ponds very difficult, the road at times being impassable while the flood water has the effect of lowering the pH of the ponds. These conditions have made it necessary to harvest ponds when opportunity occurs and at somewhat irregular intervals. Yields however have been maintained at about the same level and the crops have been sold to local labourers, European residents, sisal and tea estates and Korogwe hospital. Two consignments of a ton were sent to Handeni to assist the District Commissioner there in famine relief work.

R. E. Gould,
Fisheries Officer in Charge
(*Fish Farming*)

ANNUAL REPORT OF THE BEESWAX OFFICER FOR THE YEAR 1953

Staff

The departmental staff engaged on full time beekeeping work at the end of the year consisted of:—

1 Beeswax Officer, Mr. F. G. Smith, Tabora.

1 Assistant Beeswax Officer, Mr. S. W. G. Hubbert, Songea.

1 Junior Service Senior Beekeeping Instructor, Mr. Peter Joseph, Tabora.

40 Subordinate Service Beekeeping Instructors.

Other staff employed were:—

Chemical Assistant,

Laboratory Assistant,

Two Clerks,

Messenger,

Driver.

In addition to the forty-one Native Authority beekeeping instructors employed in 1952, a further twenty-four were trained at the beginning of 1953 bringing their number up to sixty-five spread over the central line region of the territory.

One hundred and sixty-nine agricultural instructors, twenty-one forest guards and rangers, thirteen game scouts, four natural resources instructors, three school teachers, one hundred and seventy-eight schoolboys, and five others attended beekeeping courses in various parts of the country.

Touring

During the seven months of the year that the beeswax officer was in the territory he covered 5,000 miles by road examining beekeeping areas in various parts of the country. In addition a tour of some of the beekeeping areas in Kenya was made at the invitation of the Kenya Veterinary Department and while on U.K. leave the beeswax officer visited various beekeeping research establishments, bee farms, and beeswax importers and manufacturers using beeswax.

The assistant beeswax officer undertook a considerable amount of safari in Southern Province and carried out a survey of the Upangwa region of Njombe district. The junior field officer spent the first two months of the year working in Mpanda District and in May carried out an extensive survey of the beekeeping activity in the Ugalla River Game Protected Area.

Apiculture

Out apiaries at Talikwa, near Tabora, Mpanda, Songea, Mbulu, Tengeru and Lyamungu were operated to study beekeeping conditions in different regions. Daily hive weights were recorded at Talikwa, Tabora and Songea.

In the dry woodland regions drought conditions occurred in January, the leaves on the trees wilted and the only source of nectar available was a species growing on termite mounds. In mid April there was a light honey flow but the bees were unable to get more than their day to day requirements. Between the beginning of May and the end of June the flow from *Pseudoberlina* (alias *Julbernardia*, alias *Isoberlinia*) *globiflora* enabled the Talikwa scale hive to store a surplus of forty-six pounds of honey. Between the end of June and the end of September the weight declined by twelve pounds. Light flowering at the end of September and early October caused breeding to start but no honey flow materialized. The scale hive finished the year lighter by another ten pounds.

In Tabora conditions were a little different. A very light flow took place in February increasing slightly in March but hardly maintained in April. There was however no flow in May and June and the bees made little progress up to the end of the year.

In the moister woodland in Songea the bees built up well through January and February. During May the bees made only eight pounds and from the beginning of June onwards lost weight until August when breeding was stimulated by the early flowering. From then until the end of the year there were only insignificant fluctuations.

On the whole the woodland areas produced a fair crop in May–June but the October–November crop was a failure.

Pests and Diseases

This year the main pest has been the honey badger, *Mellivora capensis sagulata*. Six frame hives were broken into at Talikwa and the colonies destroyed. Seven-eighth inch thick western red cedar hives with the corners lock jointed and nailed both ways were smashed by the powerful claws of this beast. The answer to this form of attack appears to be higher stands so that the animal cannot reach the hive from the ground and the hives stapled to the stands or secured by wedge clips so that should the beast jump onto the stand he cannot push the hives off.

None of the known bee diseases have been observed or reported in East Africa.

Beeswax Marketing

Quality has been good and prices maintained at a steady level. In the Southern Province, the intensive efforts of the assistant beeswax officer and his instructors have produced a marked improvement in cleanliness. Throughout the year there was only one complaint from overseas about Tanganyika beeswax and that was only on a matter of colour. On investigation it was found that the bad colour was caused by dirt in otherwise perfectly good beeswax.

No reliable figures for production by provinces are available. Customs returns indicated that 1953 production has been above average. The export figures for the past ten years are given below:—

	Tons	
1944	627	
1945	792	
1946	732	
1947	410	
1948	905	= dry year.
1949	525	= drought year.
1950	315	
1951	675	
1952	600	= Heavy rains.
1953 up to end September	552	
1953 estimated	760	= Drought year.
Average ...	634	

The most unsatisfactory aspect of beeswax production has been the failure on the part of Asian traders in making any distinction between clean and dirty beeswax. The result is that both in Mpanda district and Kahama district beekeepers have formed themselves into an association to deal direct with the shippers on the coast and by so doing are obtaining a better price for their clean beeswax than they would get from the local traders.

Honey Marketing

The export of poor quality honey in past years has earned a bad name overseas for Tanganyika honey. As a result prices offered by U.K. importers have been too low. The beekeepers continue to get high prices for inferior grade honey which is used for beer making. Until overseas importers can be persuaded to pay a price that will result in the beekeeper getting a higher price for table grade honey than he can get for beer grade honey there will be no incentive for him to take any care with honey preparation.

In order to give the prospective overseas buyer an indication as to the true quality of the honey being offered, a system of honey grading is being established.

Extension Work

Four beekeeping instructors' courses were held at Tabora during January and February. In June, July and August courses were held in Manyoni, Mbulu, Kondoa and Singida. Further courses were held in Mbulu and Tengeru during October, November and December. Altogether 417 people attended courses during the year.

Exhibits were displayed at the agricultural shows at Nzega and Kahama and at the natural resources show at Mbeya. Exhibits were also sent to Bulawayo for the Rhodes Centenary Exhibition.

In the field more effort has been made to instil the idea of the preservation of bee colonies. To assist in this primitive hives based on the type used on Mount Meru have been demonstrated.

The formation of associations of beekeepers in some areas of Western Province is producing closer contact with keen beekeepers. The value of improved methods is more successfully got across to the association members and through their example the ideas will spread to other beekeepers.

Research

The study of the bee botany of Tanganyika has got into its stride. Techniques and recording systems have become highly developed. The collection of pollen standards of determined species is growing daily and hive material is being collected.

Preparations are in hand for a programme of selective bee breeding to produce a more manageable strain of honey bee. Investigations into the chemical and organic methods of controlling bees are being conducted.

Forest Reserves

The great increase in the areas of deciduous woodland being made into forest reserves is in no way impeding the development of beekeeping as it is well appreciated in the Forest Department that the value of beeswax and honey obtained from these woodlands greatly exceeds the value of the yield of timber.

In the course of a programme to prevent the unnecessary destruction of large numbers of useful timber and nectar producing trees by barking, the Forest Department are making available for trial primitive hives of sawn timber.

In the upland rain forests and upland dry evergreen forests it is being realized that prohibition of entry of beekeepers into the forests is not a successful way of preventing fire damage. A system of licensing beekeepers in the forest is being introduced in the Nou Forest in Mbulu District.

Game Reserves

A survey of the Ugalla River Game Protected Area was carried out to record the beekeepers in that region and the location of their hives so that should the area be made a Game Reserve or National Park the beekeepers could be given permits to operate. However as it is now intended that the area should be only a protected area the need for giving the beekeepers permits will not arise.

Buildings

The Beekeeping Research Station is now complete with the exception of the mains electricity supply. A portable 500-watt generator permits the use of the low power appliances, but the lack of mains electricity is keeping higher powered plant idle.

Literature

The following scientific paper was published during the year:—

"Beekeeping in the Tropics". Bee World 34 (12) 233-245. F. G. Smith.

F. G. Smith,
Beeswax Officer

SOIL CONSERVATION SERVICE ANNUAL REPORT FOR THE YEAR 1953

The expansion of the field work of the Soil Conservation Service in its advisory, planning and earth moving aspects has been described in Part I of the Annual Report 1953 and it remains to summarize the investigations carried out during the year.

A system of cost accounting for each job was put into force and the following table indicates how the costs of the mechanical units were distributed.

	Total Shs.	%	Per hour worked
Petrol, oil and lubricants consumed by the tractors (including ancillary tractors for haulage, etc.)	136,228/-	19·6	5/69
Wages and rations of drivers, levellers and other staff attached to units ...	139,668/-	20·1	5/84
Spares and replacements for tractors and implements	136,590/-	19·7	5/71
Wages of workshop staff	22,934/-	3·3	0/96
Maintenance of workshop	4,990/-	0·7	0/20
Cost of transport servicing units	30,515/-	4·4	1/28
Depreciation of machinery	132,000/-	19·0	5/52
European supervision (estimated)	91,800/-	13·2	3/84
	694,772/-	100·0	29/04

A. Formal Experiments Carried Out at Tengeru

A report on three years' results (1950-52) from the first four of these experiments was submitted as an appendix to the Chief Soil Conservation Officer's monthly report for October, 1952. For convenience these results are again included below. I would again emphasize that many of these experiments are not replicated and although the conclusions which can be drawn from the figures as they stand are indicated these conclusions can at the best only be regarded as indications rather than facts.

The year 1953 was a very difficult one. The rains were late in beginning and low in amount and luck in the date of planting made considerable difference in the yield at harvest. The permanent plots (Experiments 1-4) were unlucky and in addition suffered a good deal from bird damage (not the same species as attacks wheat—a yellow weaver). The rainfall figures for the crop seasons over the past four seasons have been:—

	Inches
1950	25
1951	40
1952	13
1953	27

Experiment No. 1

Object.—Comparison of yields from bench terraces constructed at 1 ft., 2 ft., 3 ft., 4 ft., 5 ft. and 6 ft. vertical intervals.

Lay Out.—Single plots 25 ft. × 120 ft. on a 22 per cent slope. The terraces were constructed in late 1949 and early 1950 and have been planted with maize each year 1950, 1951, 1952, 1953.

Results.—The results for the four crops in (A) lb. of shelled maize per plot and (B) as percentage of the highest yield in the table below.

V.1.	1 foot		2 feet		3 feet		4 feet		5 feet		6 feet	
Year	A	B	A	B	A	B	A	B	A	B	A	B
1950	23·4	95	24·7	100	23·4	95	18·4	74	15·5	61	16·0	65
1951	34·0	40	54·5	65	84·0	100	65·5	78	64·0	76	64·5	77
1952	27·0	34	54·0	69	78·5	100	62·0	78	55·0	70	66·5	85
1953	21·2	51	34·6	84	41·3	100	29·7	72	32·9	80	38·1	92

The order of merit of the various treatments during the four seasons which the experiment has run are given in the table below. The final column shows the order of merit if the yield is corrected for the number of stems at harvest time, i.e. order of merit on a yield per plant basis. (This information is not available for previous years.)

V.1	1950	1951	1952	1953	1953
1 ft. ...	2nd= ...	6 ...	6 ...	6	6
2 ft. ...	1st ...	5 ...	5 ...	3	4
3 ft. ...	2nd= ...	1 ...	1 ...	1	2
4 ft. ...	3rd ...	2 ...	3 ...	5	5
5 ft. ...	5th ...	4 ...	4 ...	4	3
6 ft. ...	4th ...	3 ...	2 ...	2	1

Discussion.—There is little to add to the conclusions in my previous report. The two factors which tend to reduce the crops are (a) the back terrace effect and (b) competition with the vegetation on the terrace face. It would appear that the back terrace effect is diminishing in importance as compared with the competition effect as is seen in a gradual bettering of the comparative position of the plots with the higher V.I.s (and hence the fewer faces per plot).

Experiment No. 2

Object.—The comparison of yields from plots treated in various ways thought to be suitable for hillside arable cultivation.

Lay Out.—Single plots 25 ft. × 120 ft. on a 22 per cent slope cultivated as follows:—

(1) Contour ridges

(2) Tied contour ridges 1950-52. Flat in 1953.

(3) Matengo pits (Tengeru variation of). Large pits approximately 4 ft. × 4 ft. × 3 ft. dug at regular intervals in the plots into which all weeds and plant refuse are thrown. When the plots are full new ones are dug intermediate between the old ones. New pits were dug in 1953.

(4) Constructed bench terraces with a V.I. of 5 ft.

(5) Forming bench terraces with elephant grass barriers at 5 ft. V.I.

(6) Narrow base contour banks at 5 ft. V.I.

Owing to the narrowness of the plots the contour ridge and tied contour ridge plots were really indentical since in the contour ridge plot the sides of the plot formed an effective tie. The tie ridged plot was therefore cultivated on the flat in 1953 so as to give a control for comparison with other treatments.

In addition to the main soil conservation treatments the following spacing treatments were superimposed in 1953. The reason for this as indicated in last year's report was that some of the main treatments necessarily resulted in differences in total plant population per plot. It was thought desirable to try to distinguish if possible between differences due directly to the conservation treatments and differences due to the secondary effect of variation in population, e.g., the forming bench terrace plot necessarily carried fewer plants than the flat plot (if both were planted with similar spacings) since the elephant grass takes up some space. It might be possible to make up for the reduction in space available by planting closer. With this in mind the subtreatments imposed were:—

A.—Plant population—3 ft. × 1 ft. spacing on constructed bench terrace plot, i.e., 253 holes per sub plot.

B.—Plant population—3 ft. × 1 ft. spacing on narrow based contour bank plot, i.e., 161 holes per sub plot.

C.—Plant population—3 ft. × 1 ft. spacing on Matengo pit plot, i.e., 212 holes per plot.

Since the experiment is not replicated it was impossible to randomize these subtreatments which ran from top to bottom of the plot in the order A.B.C.

Results.—The results in (A) lb. of shelled maize per plot and (B) as percentage of the highest yielding plot are given in the table below.

Treatments	Ridges		Tied Ridges		Flat		Matengo Pits		Construc-ted Terraces		Forming Terraces		N'base Cont. Banks	
Year	A	B	A	B	A	B	A	B	A	B	A	B	A	B
1950	204	87	220	93	–	–	236	100	188	80	176	75	153	65
1951	56	43	63	49	–	–	129	100	57	44	28	22	35	27
1952	102	91	101	90	–	–	112	100	73	65	20	18	41	37
1953	102	95	–	–	101	94	107	100	42	39	13	12	20	18

The results of the subtreatments were as follows:—(Lb. shelled maize per plot)

	Ridges	Flat	Matengo Pit	Constructed Terraces	Forming Terraces	N'base Cont. Banks
Spacing A ...	27	23	32	14	3	4
B ...	32	34	32	12	5	5
C ...	43	44	43	16	5	11
Total	102	101	107	42	13	20

Discussion.—The Matengo pit plot has maintained its consistent superiority over the other treatments although there is little in it between the ridged, flat and matengo pit plots. There is an indication that the superiority of the Matengo pit plot is due to a better comparative yield on the top third, i.e., since spacing A and spacing C are very similar and since both ridged and flat plots show a considerable diminution of yield in the top third as compared with the bottom third this superiority if it is a fact is due to the Matengo pit system yielding better crops on poorer soil.

It should be noted in regards to the flat plot that as it has been ridged in previous years and since the rainfall this season was very low there has been little cumulative erosion effect. Nevertheless the yield at the top of the flat plot is lower than that in either the ridged or Matengo pit plot (possibly a moisture effect if not an actual erosion effect.)

The effect of the spacing treatments has had little effect on the comparative yields of the plots and it can only be concluded that the poor yields on the terraced and contour banked plots are primarily due to the conservation treatment as such and not to the secondary effects of the different plant populations resulting from the treatments.

Experiment No. 3

Object.—Comparison of yields from (a) plots without any conservation treatment (flat), (b) plots with constructed bench terraces and (c) plots with forming bench terraces.

Lay Out.—Randomized blocks with five replications, plot size 25 ft. × 120 ft. on a 22 per cent slope. Plots (b) and (c) are divided into half plots (i) terraced at 3 ft. V.I. and (ii) terraced at 6 ft. V.I. These half plots are not randomized (i) being at the top.

In 1953 the following subtreatments were applied being randomized in each plot.

A. Spacing to give a total plant population—3 ft. × 1 ft. on flat plots.

B. Spacing to give a total plant population—3 ft. × 1 ft. on constructed bench terrace plots.

The idea of putting down these subtreatments was again to try to distinguish between the primary conservation effects and differences due to the secondary effects of population differences.

Results.—The results of the main conservation treatments are given in lb. shelled maize per acre in the table below for the four years the experiment has run.

Treatment Year	Flat	Constructed Terraces	Forming Terraces	% S.E./G.M.	Sig. Diff. P = ·05
1950	2,799	1,947	2,331	8·7	297
1951	747	852	453	16	162
1952	1,055	580	295	35	515
1953	467	403	268	10·5	34·6

The results of the spacing subtreatments this year and the interactions are shown in the table below (lb./acre).

	Flat	Constructed Terraces	Formed Terraces	Mean
Spacing A	491	524	353	456
B	443	281	182	303
Mean	467	403	268	

The difference between the spacing treatments is significant at the P = .001 level as is also the interaction between the spacing treatments and the conservation treatments.

Discussion.—While the flat treatment gave the best overall yield and the higher planting rate was better than the lower the most interesting result is the significance of the interaction which is clearly seen in the second of the above tables to be due to the fact that higher spacing gives a much greater increase in yield when combined with the conservation treatments than it did on the flat, i.e., the secondary loss in yield consequent on the reduction in plant population on the soil conservation treatments can be compensated for by increasing the stand. In fact the highest yield was obtained from those bench terraces which were planted at the thicker rate.

Owing to the fact that the half plots on the six ft. V.I. and the three ft. V.I. are not randomized it is impossible to separate out this effect from the natural effect of the soil at the foot of the plots being better than that at the top. It is of interest to note however that comparison between the best flat lower half planted at the thicker rate and the best constructed terraced lower half planted at the thicker rate showed yields in the ratio of 64 : 94.

Experiment No. 4

Object.—To compare the yields from bench terraces constructed in different ways.

Lay Out.—Single plots 24 ft. × 94 ft. The treatments were:—

(a) Bench terraces constructed in the usual way by removing the soil from the back of terrace and pulling it to the front, so burying the original top soil in the front.

(b) Bench terraces constructed as in (a) but the top soil from one terrace is spread over the terrace below to a depth of about 1 inch. (The top-most terrace is, of course, completely denuded of top soil and is not included in the plot).

(c) Bench terraces constructed by making a small terrace on the lower half of each terrace and then in each subsequent year digging further into the face of the terrace above and pulling the soil forward so increasing the size of the terrace until the face is vertical. It is essentially the same as the forming bench terraces in Experiments 2 and 3 without the elephant grass but simply a small bank on which the terrace is formed.

These terraces were constructed early in 1951. All are at a V.I. of 4 ft. Beans were taken in the 1951 short rains and maize in the 1952 long rains.

Results.—Results are given below in lb. per plot.

Treatment Year	A	B	C
1951 (Beans) ...	46	51	41
1952 (Shelled Maize) ...	70	78	66
1953 (Shelled Maize) ...	40	42	39

Discussion.—Differences are negligible.

General Discussion of the Above Results and their Practical Implications

The only common treatment in the above trials is constructed bench terracing at 5 ft. to 6 ft. V.I. This treatment has in fact yielded at much the same rate in all trials (40 lb. shelled maize per plot—580 lb./acre in 1953). If this is accepted as a common standard it might be said that bench terraces with about this V.I. may be expected to reduce yields as compared with cultivation on the flat or on ridges but that there are indications that this reduction in yield can be overcome by closer planting at least after three or four years have elapsed since the first construction of the terrace. On the slopes 20 per cent to 25 per cent terraces with a V.I. of less than three feet are unlikely to be satisfactory owing to competition between the crop and vegetation on the terrace face. Attempts to form bench terraces against elephant grass barriers are likely to result in considerable loss in yields for at least a number of years. Tie ridging is an adequate conservation treatment on slopes of up to 22 per cent. The Matengo pit system or variants of it appear to be the most satisfactory method of cultivation on slopes up to at least 22 per cent. It has the great advantage that it requires no instruments for levelling and it is an automatic system of fertility maintenance (which probably explains why it has retained its consistent superiority in the trials at Tengeru).

B. Experiments with Mulch

These experiments arose out of the observations on two demonstration plots which were reported on last year. To recapitulate, the initial object of the demonstration plots was to demonstrate to visitors the amount of soil loss due to erosion and how it could be prevented by mulching. Two plots of one-fifth-acre size were set up in 1951 and arrangements made to collect the silt carried by the run-off from each plot. One plot was covered with maize stover at the rate of ten tons per acre. Maize was planted on both plots. In 1952 the plots were reversed, the plot which was mulched in 1951 being bare in 1952 and vice-versa. Maize was planted in both plots each year.

The results of these two years' experiments were:—

	1951	1952
Yield of maize from mulched plot	105·5 lb. ...	283 lb.
Yield of maize from unmulched plot	440·0 lb. ...	328 lb.
Soil loss from mulched plot	2,500·0 lb. approx.	Nil
Soil loss from unmulched plot	10,500·0 lb. approx.	Nil

Two Latin squares were laid down in 1953 and the results are detailed below.

Trial A

Object.—To test the effect on the yield of maize of various types of mulch applied to a maize crop just before planting.

Lay Out.—Latin square, plots 24 ft. × 10¼ ft., with treatments as follows:—

A. Maize stover at rate of 5 tons/acre applied to surface just before planting.

B. Dolichos formosus straw at rate of 5 tons/acre applied just before planting.

C. Maize stover at rate of 5 tons/acre + 3 cwt. sulphate of ammonia applied on surface just before planting.

D. F.Y.M. at 5 tons per acre applied on surface just before planting.

E. Control.

Results.—The results are given in the table below. The acreage yields are calculated as $\frac{1}{3}$ cob weights.

Treatments	A	B	C	D	E	*Sig. Diff.* P=·05 P=·01		% S.E. G.M.
Wt. cobs per 5 plots lb. ...	112	179	149	212	217	39	77	16
Yield per acre lb.	1,329	2,123	1,696	2,515	2,574	462	913	
% Control	51·6	82·5	68·6	97·7	100	18·0	35·5	

Trial B.

Object.—To test the effect on the yield of maize of organic matter applied in various ways.

Lay Out.—Latin square plots 24 ft. × 10¼ ft., treatments as follows:—

A. 5 tons/acre maize stover hoed into soil in December before planting. (Planting time March/April).

B. 5 tons/acre maize stover applied on surface in January.

C. 5 tons/acre maize stover applied on surface just before planting.

D. 5 tons/acre maize stover laid on wire about 6 inches above ground just before planting.

E. Control.

Results.—The results are given in the table below. The acreage yields are calculated as $\frac{1}{3}$ cob weights.

Treatment	A	B	C	D	E	Sig. Diff.	% S.E. G.M.
Wt. cobs per 5 plots lb.	211	190	193	204	235	Insig.	23
Yield per acre, lb.	2,503	2,254	2,289	2,420	2,789		
% Control	89·8	80·8	82·1	86·8	100		

Mean of Mulch treatments =2,787 lb./acre.
Mean of Control =2,366 lb./acre.

This difference of 17½ per cent does not quite reach significance.

Discussion.—The depressing effect of mulch has been fully confirmed, particularly in Trial A. It is noticeable in Trial A that the F.Y.M. mulch did not raise the yield at all (compare results of "*Broadbaulk*" trial noted below) nor did the application of sulphate of ammonia with the mulch obviate the depressing effect of the mulch. The object of treatment D in Trial B was to try to isolate the shade effect of mulch from any microbiological effect resulting from contact with the soil but practical difficulties arose because the mulch was not heavy enough to suppress weed growth and it proved impossible to weed the plots satisfactorily without damaging the maize. This was partly responsible for the high error in Trial B. The depressing effect is almost certainly due to inhibition of nitrate accumulation by the mulch which effect has been recorded from Uganda (See "A note on Nitrate Accumulation in a Uganda Soil" by G. Ap. Griffiths and H. L. Manning in *Tropical Agriculture* 1949.)

The two trial sites have been replanted with a short rains maize crop to see if any residual effects show up and as indicated above I also hope to devise some critical experiments for next season.

C. Bush Breaking and Grass Breaking Trials

All farmers in the Northern Province aver that if land is broken out from bush it is three seasons before it reaches maximum production. In one reported case the same phenomenon was said to occur when an artificial grass ley was ploughed out. It was thought desirable to confirm if possible these reports and to this end two experiments have been laid out at Tengeru and one at Oljoro.

A. One on new land i.e. previously unbroken, which is laid out as a 5 × 5 Latin square, one "treatment" being broken out each year beginning in 1953. Hence in 1957 we shall have a comparison of:—

   A. Maize on newly broken land.

   B. Maize after one year's maize.

   C. Maize after two years' maize.

   D. Maize after three years' maize.

   E. Maize after four years' maize.

B. On a field sown with Rhodes grass in 1950 a 5 × 3 randomized block has been laid out. This is being put through a rotation of five years' maize followed by three years under Rhodes grass. Five plots have been ploughed out this year and in subsequent years we shall get a comparison as in A.

No results from these major treatments will of course be available until next season but for interest in trial A we superimposed on the main treatment sub-treatments consisting of.

(i) One cultivation prior to planting i.e. plots broken, cultivated and planted on 9.4.53.

(ii) Two cultivations prior to planting, i.e. plots broken and cultivated 17.12.52 cultivated and planted 9.4.53.

The results of these treatments were:—

	Total cob wt.	Approx. lb./acre
One cultivation prior to planting ...	... 202	... 1,480
Two cultivations prior to planting ...	... 482	... 3,220

The difference is highly significant. The results simply confirm the well known fact that the earlier you break out new land before planting and the more you work it the better yield you are likely to obtain.

C. A trial has also been laid out at Oljoro on virgin land, the intention being to put this through a rotation of five years' maize followed by three years' ley. The first plots were broken in 1953 and maize planted. The main plots were and will be split for subtreatments of:—

   (a) Sulphate of ammonia in first year of breaking.

   (b) No manure in first year of breaking.

The 1953 crop failed entirely in common with all other crops in the area. Before the crop dried the sulphate of ammonia was observed to be giving better growth (but compare next experiment).

D. "Broadbalk" Trial

This trial is intended to be a permanent trial and the object is to see what effects continued application of various manures will have. Five tons per acre of kraal manure is taken as a standard and equivalent amounts of N;P. N+P as are calculated to be contained in the kraal manure are applied as the other treatments. It was considered that in the recent volcanic soil of Tengeru K was unlikely ever to be lacking and as space was limited the treatments were confined to the use of N and P.

Lay Out.—A 5 × 5 Latin square, plots 48 ft. × 18 ft., treatments as follows:—

A. Kraal manure 5 tons/acre.

B. Sulphate of ammonia equivalent to 250 lb. N/acre.

C. Superphosphate equivalent to 77½ lb. P_2O_5.

D. B+C.

E. Control: No manure or fertilizer.

Results.—In 1953 maize was planted on the trial. The yields were as follows:

Treatment	A	B	C	D	E	Sig. Diff.	$\frac{\%\text{ S.E.}}{\text{G.M.}}$
Shelled Maize per 5 plots	300	289·5	271·5	278·6	280·5	Insig.	7·45
% Control	107	103	96·8	99·3	100		
Approx. lb./acre	3,000	2,895	3,715	2,786	2,805		

In spite of the reasonably low experimental error there is no significance whatsoever between any of the treatments or any combination of treatments. The sulphate of ammonia plots appeared to give a greener and more luxuriant growth in the early stages but this was not reflected in the yields. No soil difference between the plots was observed.

E. Ridging and Spacing Trial

Object.—This trial was inspired by consideration of the results which had been obtained in some of the permanent trials where as indicated in the discussions above it was suspected that some of the results which were ascribed to conservation treatments might be due to variations in plant population which were inherent in such treatments. The trial as laid down was designed to find the effect on the yield of maize of (a) different planting distances in the rows and (b) different arrangements of the rows due to tie ridging.

Lay Out.—A 6 × 3 randomized block with split plots with the following main treatments:

(1) Maize planted 1 ft. apart in the row.

(2) Maize planted 1½ ft. apart in the row.

(3) Maize planted 2 ft. apart in the row, and the following subtreatments:

(a) Double rows on tied ridges, ridges 5 ft. apart, no plants on ties.

(b) Double rows on flat, 5 ft. apart.

(c) Single rows on flat, 2½ ft. apart.

Results.—The results are given in the table below as yields in lb. per acre.

Treatments	1	2	3	Mean
A	2,553	3,003	3,252	2,936
B	2,614	3,064	2,643	2,774
C	2,984	3,164	3,165	3,095
Mean	2,717	3,068	3,020	

There are no significant differences between the treatments or between any combination of treatments nor is there any significant interaction.

Discussion.—The results of this trial as far as tie ridging *v* flat is concerned confirm other trials carried out in Arusha District where ridging did not seem to have any significant effect and it also of course agrees with the results of the permanent trials. Within very wide limits plant population and the distribution of that population within a field seems to make very little difference to yield. This is in accord with practical experience in this area. The choice of planting distance is probably best determined by considerations such as ease of cultivation, width of implements and so on rather than by aiming at a theoretical best planting distance.

F. Trials of Terraces on Various Grades

A series of terraces laid out on various grades and intervals was laid out at Oljoro in early 1953. During the 1953 long rains which amounted in all to less than 8 in. no run off occurred on the experimental field and no observations resulted. The terraces are being maintained for observation in subsequent seasons.

G. Undersowing Trials—Tengeru

The object of this trial is to find the best technique for undersowing maize so that when the nurse crop is harvested a ground cover of grass, legume or both remains. The need for finding this technique is great especially where a strip cropping system is used in the farm plan.

The first trial was made in 1952. Giant star grass and Rhodes grass were underplanted and undersown respectively. The treatments were a complete failure probably due to the lack of rain.

This year the treatments were:—

Strip 1.—Rhodes Grass—$\frac{1}{2}$ undersown immediately after 1st weeding—$\frac{1}{2}$ underplanted immediately after 1st weeding.

Strip 3.—Giant star Grass—$\frac{1}{2}$ underplanted immediately after 1st weeding—$\frac{1}{2}$ underplanted immediately after 2nd weeding.

Strip 5.—Dolichos formosus—$\frac{1}{2}$ undersown 6 days after 1st weeding—$\frac{1}{2}$ undersown immediately after 2nd weeding.

Results.—When the maize was about four feet high the undersowing treatments looked quite promising especially the half-strip sown to Rhodes grass. However when the maize had been harvested and stooked the ground cover consisted mostly of weeds plus loose maize stover. At the time of writing an attempt is being made to get this stover and weed growth grazed off. Subsequently a mower will be run over the strips to cut back the tallest and most unpalatable of the weeds.

The treatments this year although far from giving entirely satisfactory results do show that modifications of the methods adopted may produce the desired effect. In particular sown Rhodes grass and Dolichos formosus either sown or planted are worthy of further trial on the following lines:—

1. Under a wider spacing of the nurse crop.
2. With earlier planting of the ground crop in relation to the planting of the nurse crop. In 1954 planting or sowing will be carried out simultaneously. It may even be that the ground crop would be best planted before the nurse crop.
3. With the use of selective weed killers in the case of ground grasses.
4. With short stemmed nurse crops, i.e. a short stemmed maize variety.
5. By cutting the nurse crop for silage when about four feet tall.

L. J. S. Littlejohn,
Chief Soil Conservation Officer

SUMMARY OF THE ANNUAL REPORT OF THE AGRICULTURAL OFFICER (EXPERIMENTS), IRINGA, SOUTHERN HIGHLANDS, FOR THE YEAR 1953

Reference will be found to tobacco experimental work under the heading "Igumbiro Tobacco Farm".

Wheat Experiments

Work continued during the 1953 season on the investigation of times of planting, rates of seeding, residual effect from fertilizers applied during 1952 and of suitable wheat varieties for all altitudes.

Variety Trials.—The main emphasis was again on trials to find varieties for the various altitudes and environments in the province. This work was increased in 1953, Njombe District was included and no less than eleven trials were conducted in the wheat growing areas. The altitude range was from 5,300 to 7,300 feet and between the latitudes of 8° and 9° South. All trials were lattice squares of nine varieties in two replications with plots of one hundredth and one eightieth of an acre.

Discussion of Trials

Iringa District—below 6,300 *feet*

For the low altitude group the best varieties were not as clear cut as during last season. Summarized briefly results were as follows:—

Best Variety	44/W/1
Good varieties	182P2AIA, 261R7CIB 291J111, Kenya Settler
Poorest variety	350AD9C2

Among the farming community 261S1OC2D has been the most reliable.

Iringa District—above 6,300 *feet*

Best variety	291J111
Good varieties	337BE2F2, 338AA1A2 Regent 975·6, 321BT1B1
Poorest variety	341F2D2

Mbeya District—below 6,300 *feet*

Best varieties	44/W/34
Good varieties	44/W/1, Kenya Settler 341F2S1, 291J111
Poor variety	341F2D2

The two South African varieties (44/W/34 and 44/W/1 have done extremely well at the two trials in this zone. 44/W/34 has broken all records with the calculated yield of 16⅔ bags per acre, equivalent to 29 cwt. per acre, and a good yield even on English standards.

Mbeya District—over 6,300 *feet*

Best variety	341F2D2
Good varieties	350AD9C2, 291J111 294M7C6A, 337BE2F2
Poor variety	321BT1B1

For the high altitude the same varieties appear at the top as last year, namely 341F2D2 and 350AD9C2.

Considering the low rainfall yields were very high possibly due to the powers of retention of moisture, characteristic of the volcanic and forest soils on which the trials were sited. This district also has a higher rainfall than that of Iringa.

Njombe District

The trials were only a moderate success and both low altitude trials acted as if the sites were at medium to high alltitudes for 291J111, 337BE2F2, 184P2A1F and 341F2D2 were the best four, three of which are classed as medium to high altitude wheats. For the high altitude centre where only one trial was planted, 35OAD9C2 and the local Sabenero were the two best varieties.

Fertilizer Trials

Iringa District

Two trials were attempted at Igumbiro to see if a method of catch cropping could be used in which a green manure was planted with an available form of phosphate at the onset of the rains, ploughed in, and followed by wheat. The drought was so severe that the wheat did not become properly established and both trials were unsuccessful.

A fertilizer trial laid down at Sao Hill last year was planted again with barley to test residual effect. Significant results were obtained from the potash-dung treatment while phosphate just failed to give significant response. The more economic treatments were N2 P1 K (a complete fertilizer), and N1 D.

Nitrogen has been of little value except where used with dung. All these results lead to one conclusion that phosphates are essential on these sandy Iringa soils.

Sao Hill Residual Fertilizer Trial

The trial was designed in 1952 as a 3 × 3 × 3 partially confounded factorial experiment with twenty-seven treatment combinations. It was planted on 9th–11th February with a six row feeding barley to test residual effects of the following treatments applied during 1952.

1. Nitrogen at 15 and 21 lb. N2 per acre
2. Phosphate at 50 and 75 lb. P-205 per acre
3. Potash at 50 lb. per acre
4. Dung at 5 tons per acre

} All placed below the seed

Germination was good and the drought did little to set back the trial. Stands were extremely thick.

In the analysis of variance a significant linear response was given by the Potash–Dung treatment and Phosphates just failed to give a significant curvature response.

Treatment	Wheat Yield lb./Acre	Barley Yield lb./Acre
Control	548	1,157·2
N.1	579·2	1,414·8
N.2	704	1,327·6
P.1	734	1,334·8
P.2	946	1,064·8
N1.P1	1,046	1,380
N1.P2	934·6	1,044·8
N2.P1	950	1,284·8
N2.P2	1,256·8	1,452·4
K	900	1,387·2
NIK	694·8	852·4
N2K	992	1,330
P1K	1,242	1,494·8
P2K	1,450	1,180
N1 P1 K	1,258	1,470
N2 P1 K	1,530	1,680
N1 P2 K	1,252	1,340
N2 P2 K	1,350	1,360
D	922	1,262·4
N1 D	1,386	1,592·4
N2 D	990	1,590
P1 D	1,390	1,424·8
P2 D	1,180·8	1,582·4
N1 P1 D	1,390	1,534·8
N2 P1 D	1,486	1,570
N1 P2 D	1,246	1,405·6

The significant difference between treatments was 593·6 lb. per acre at the 5 per cent level and 806·8 lb. per acre at the 1 per cent level.

Mbeya District

A residual trial was similarly planted with barley on last year's fertilizer experiment in the Porotos. A large significant residual response was given by dung. The calculated average yield was 1,649 lb. per acre with dung and the highest yield without dung was only 554 lb. per acre. The highest yield per acre is given by dung itself and fertilizers have tended to decrease yields.

The 3 × 2 × 2 × 2 partially confounded factorial fertilizer trial in the Porotos Mountains was planted to barley. Planted in March it germinated well but subsequent growth was spasmodic. On all plots where dung had been applied normal growth was obtained; on non-dunged plots bare patches were seen together with poor and indifferent growth.

The treatments applied during 1952 were:—

1. Sulphate of ammonia at 0·2 cwt. N2 per acre.
2. Double superphosphate at 56 lb. P205 per acre.
3. Muriate of Potash at 40 lb. K. 20 per acre.
4. Dung at 5 tons per acre.

Treatment	Wheat Yield lb./acre	Barley Yield lb./acre
Control	1,046 ...	708
K	962·7 ...	787·3
L	1,046 ...	878·7
KL	481·3 ...	179·3
P	804·7 ...	267·3
PK	621·3 ...	437·3
PL	744 ...	912·7
PKL	804·7 ...	545·3
N	677·3 ...	333·3
NK	1,189·3 ...	562·7
NL	804 ...	737·3
NKL	1,187·3 ...	712·7
NP	646 ...	388
NPK	1,054·7 ...	804
NPL	817·3 ...	383·3
NPKL	750 ...	228·7
O	1,977·3 ...	1,828·7
OK	1,683·3 ...	1,637·3
OL	1,927·3 ...	1,492
OKL	1,322·7 ...	1,746
OP	1,229·3 ...	1,624·7
OPK	1,490 ...	932·7
OPL	1,985·3 ...	2,158·7
OPKL	1,816·7 ...	1,770·7

Significant differences 5 per cent 486·5 for wheat, 381·4 for barley, 1 per cent 583·4 for wheat, 457·3 for barley.

Cultural Trials

Iringa District

A time of planting cum variety trial at Dabaga successfully revealed how each variety required to be planted at a specific period during the rains in order to give its highest yields. The late maturing variety 360 H yielded best when planted during the first few days of February and 261S10C2D yielded best when planted between the second and third weeks in February. The actual dates only apply to the Dabaga area as other areas have different climatic conditions, especially rainfall distribution. A time of planting cum rate of seeding trial also at Dabaga showed that apart from the earliest sowing when 100 lb. per acre yielded significantly better than 70 lb., the rate of 70 lb. per acre did just as well and better than the high rates of sowing. The optimum date of planting was the 10th February and on this date the highest yield and shortest growing period was recorded. No significant differences were obtained in a rate of sowing trial at Sao Hill.

Tiller counts on different varieties indicated that certain varieties did not have a freely tillering habit and in consequence needed higher rates ef seeding. The optimum straw densities may be twenty stalks per foot and these densities are affected more by date of sowing than by seed rates.

ANNUAL PYRETHRUM REPORT, 1953

General

Pyrethrum experimentation was continued during the 1953 season on the farmers' dispersed experimental station at Uwemba in the Njombe district. The work was only moderately successful this season because of the bad year. Planting of experiments was not possible until February. Yields on the whole were very much lower than they have been for several years.

The work of organizing the year's programme was done by Col. L. A. Notcutt and the picking and recording of all data was done by the two graded African recorders. The Agricultural Officer (Experiments) tendered advice on experimental layout and technique, visited each experiment several times during the course of the year and analysed the data.

Experimental Work .

Three of the four original fertilizer trials were continued to completion during the year to ascertain residual responses. The fourth was destroyed by sheep half way through the season. Several new trials were started investigating type and size of planting material, placement of fertilizer, disease control and planting technique.

Experiment No. 1

Object.—To investigate direct and residual effects of applying lime and double superphosphate to pyrethrum planted at three different spacings in the rows.

Design.—A 3 × 3 × 3 × 3 partially confounded factorial experiment of twenty-seven plots in one replication with plot size one-hundredth acre.

Site Soil.—The trial was sited on a deep volcanic ash overlying a red loam on Muwengi Farm, Uwemba.

Treatments.—(a) Lime at 0, 2(L1), and 4 tons per acre.

(b) Double Superphosphate at 0, 150(P1) and 300 (P2) lb./acre.

(c) Spacing at 6 in. (S1), 9 in. (S2) and 12 in. (S3) between plants in the row (rows, 2 feet apart.)

Results.—In 1950 there was a significant linear response to phosphate at the 1 per cent level and also a linear significant response to the closer spacing.

In 1951 there was nothing significant.

In 1952 there was a significant linear response to phosphate.

In 1953 there was nothing significant.

Over the four years' work phosphate has given a significant linear response.

YIELD—IN LB. PER ACRE OF DRIED FLOWERS

Phosphate	No Phosphate lb.	150 lb. Phosphate per Ac./lb.	Increase over nil lb.	300 lb. Phosphate lb./Acre	Increase over 150 lb.	Increased over nil lb.
1950	662·1	697·8	35·7	838·2	140·4†	176·1†
1951	1,367·9	1,323·3	–44·6	1,486·4	163·1	118·5
1952	968·3	990·4	22·1	1,098·4	108·0†	130·1†
1953	606·4	619·7	13·3	673·6	53·9	67·2
1950-53	3,604·7	3,631·2	26·5	4,096·6	465·4	491·9*
Average Price 2/20/lb.	7,930·03	7,988·64	58·3	9,012·52	1,023·88	1,082·18

Lime	No Lime	2 Tons lime/acre lb.	Increase over nil	4 tons per acre	Increase over 2 tons	Increase over nil
1950	777·0	700·5	–76·5	725·7	25·2	–51·3
1951	1,419·7	1,366·8	–52·9	1,391·1	24·3	–28·6
1952	1,031·3	1,005·4	–25·9	1,020·5	15·1	–10·8
1953	634·7	610·4	–24·3	654·6	44·2	+19·9
1950-53	3,862·7	3,683·1	–179·6	3,791·9	108·8	–70·8
Average Value 2/20/lb.	8,497·94	8,102·82	–395·12	8,342·18	239·36	–155·76

Spacing	12 in. lb.	9 in. lb.	Increased over 12 in. lb.	6 in. lb.	Increased over 9 in. lb.	Increased over 12 in. lb.
1950	660·0	695·9	35·9	842·2	146·3†	182·2†
1951	1,387·5	1,378·0	–9·5	1,412·0	34·0	24·5
1952	1,019·2	1,005·3	–13·9	1,032·6	27·3	13·4
1953	620·2	617·4	–2·8	662·2	44·8	42·0
1950-53	3,686·9	3,696·6	+9·7	3,949·0	252·4	262·1
Average Value 2/20/lb.	8,111·18	8,132·52	21·34	8,687·80	555·28	576·62

*Denotes significance at 5% and †Denotes significance at 1% level.

Discussion.—(a) 1953.—Although the response to phosphate was not significant this season the treatment of 300 lb. per acre of superphosphate has nevertheless given a 11·08 per cent increase over where no phosphate was applied.

(b) 1950-53.—Over the life of the experiment phosphate at 300 lb. has conclusively shown itself to be the most economical level. For the expenditure of Shs. 80/- per acre on superphosphate in 1949 a return of Shs. 1,082.8 has been given by 300 lb. per acre. This represents an increase of 13·65 per cent over the untreated area.

The use of lime has had a depressing effect on yields to the tune of Shs. 321/- for L1 and Shs. 190/- for L2. It is concluded that it is of no value to pyrethrum on the Uwemba soils.

Spacing at 6 in. gave an initial increase in the first year but during succeeding years this spacing has failed to yield significantly better than 9 in. or 12 in. spacings. Over the four years it has given an increase of Shs. 462.21 over 12 in. and Shs. 435.96 over 9 in. It is concluded that there is an advantage in planting at 6 in. in the first year and thereafter the alternate plants can be removed if desired or left. By leaving it is observed that weed growth is suppressed between plants.

Experiment No. 2

Object.—To test the direct and residual effects of double superphosphate, lime, and sulphate of ammonia.

Design.—A $3 \times 3 \times 3$ partially confounded factorial experiment of one replication, using plots one-hundredth acre.

Soil and Site.—The trial was planted on Nuwi plantation, Uwemba, during 1949. The soil on which it is sited had a shallow humic sandy layer over a sandy subsoil.

Treatment.—(a) Lime 0, 2(L1) and 4(L2) tons per acre.
(b) Double Superphosphate at 0, 150(P1) and 300 (P2) lb./acre.
(c) Sulphate of Ammonia at 0, 100(N1) and 200(N2) lb./acre.

Result.—In 1950 phosphate gave a highly significant response whilst nitrogen only just failed to be significant.

In 1951 the same pattern was repeated.

In 1952 nothing was significant although phosphate just failed to give a significant residual response.

In 1953 nothing was significant.

Over the four years the linear response to phosphate was highly significant and nitrogen just failed to reach linear significance.

YIELD—IN LB. PER ACRE OF DRIED FLOWERS

Phosphate	No Phosphate	150 lb. P205/acre	Increase over nil	300 lb. P205/acre	Increase 150 lb.	Increase over nil
1950	349·7	468·0	118·3†	541·9	73·9†	192·2†
1951	575·8	719·3	143·5†	735·8	16·5†	160·0†
1952	288·3	336·1	47·8	349·8	13·7	61·5
1953	154·5	174·1	19·6	181·3	7·2	26·8
1950-53	1,368·3	1,696·5	328·2*	1,808·8	112·3	440·5*
Average Value at Shs. 2/20/lb....	3,010·26	3,732·30	722·04	3,979·36	247·06	969·10

Sulphate of Ammonia	No Sulphate of Ammonia	100 lb. per acre lb.	Increase over nil lb.	200 lb. per acre lb.	Increase over 100 lb.	Increase over nil lb.
1950	423·6	445·8	22·2	490·3	44·5	66·7
1951	638·5	687·0	48·5	705·4	18·4	66·9
1952	295·8	316·7	20·9	361·7	45·0	65·9
1953	156·9	159·9	3·0	192·1	32·2	35·2
1950-53	1,514·8	1,609·4	94·6	1,749·5	140·1	234·7
Average value at Shs. 2/20/lb. ...	3,332·56	3,540·68	208·12	3,848·90	308·22	516·34

Lime	No Lime lb.	2 tons Lime lb.	Increased over 2 tons lb.	4 tons lb.	Increase over 2 tons lb.	Increase over nil lb.
1950	463·7	444·6	–19·1	448·2	3·6	–15·5
1951	650·0	661·5	–11·5	719·4	57·9	69·4
1952	316·2	316·1	–0·1	341·9	25·8	25·7
1953	166·2	167·3	1·1	175·5	8·2	9·3
1950-53	1,596·1	1,589·5	–6·6	1,685·0	95·5	88·9
Average Value at Shs. 2/20/lb....	3,511·42	3,496·90	–14·52	3,707·00	210·10	195·58

*Denotes significance at 1 per cent and †Denotes significance at 0·1 per cent.

Discussion.—(a) 1953.—The results of this year's pickings were not significant due possibly to the dry season. The yields from phosphate-treated plots were 12·68 per cent and 17·35 per cent higher respectively from the low and high rates than where no such treatment had been applied.

(b) 1950-53. A significant linear response has been given over the four years which is equivalent to 23·99 per cent and 32·19 per cent increases over control by the low and high rates of application. It is interesting to note that the 8.20 per cent difference was practically all given in the first year. Unlike Experiment 1 where the 150 lb. per acre application was rendered unavailable from the beginning, this trial has given a much higher response from the initial 150 lb. per acre. Lime has never given a positive or negative significant response and therefore it is considered to be of no practical value.

Sulphate of Ammonia has had an inexplicable effect which although never gaining significance has nevertheless continued to raise yields by quite a remarkable amount and why after four years it should continue to give increases is not at all apparent.

It is probable that it may have had some effect in promoting micro-organisms. The use of Sulphate of Ammonia is to be investigated further in 1954.

Experiment No. 4

Object.—To investigate the effects of double superphosphate and compost applied to pyrethrum planted at three spacings.

Design.—A $3 \times 3 \times 3$ partially confounded factorial experiment of twenty-seven plots in a single replication with one-hundredth acre plots.

Soil and Site.—It was sited on Fairhills farm during 1949 but in its first year it was severely damaged by cattle. The soil on which it was sited was a clayey forest soil overlying a deep clayey loam.

Treatment.—(a) Compost at 0, 5, (C1) and 10(C2) tons per acre.

(b) Double superphosphate at 0, 150(P1) and 300(P2) lb. per acre.

(c) Spacing at 6 in. (S1); 9 in. (S2) and 12 in. (S3) between plants in the row. (Rows 2 ft. 4 in. apart).

Results.—In 1951 there was a significant linear response to phosphate and an interaction between spacing and phosphate.

In 1952 nothing was significant although both phosphate and spacing approached significance.

In 1953 there was nothing significant.

1950-53 there was a significant linear response to phosphate.

YIELD—IN LB. PER ACRE OF DRIED FLOWERS

Phosphate Year	No Phosphate	150 lb.	Increase over nil	300 lb.	Increase over 150	Increase over nil
1951	574·4	608·4	34·0	680·0	71·6**	105·6**
1952	357·9	381·2	23·3	413·8	32·6	55·9
1953	280·8	269·4	–11·4	296·8	27·4	16·0
1951-53	1,213·1	1,259·0	45·9	1,390·6	131·6*	177·5**
Average Value @ Shs. 2/20/lb....	2,668·82	2,769·80	100·98	3,059·32	289·52	390·50

Spacing Year	12 in. lb.	9 in. lb.	Increase over 12 in.	6 in. lb.	Increase over 9 in.	Increase over 12 in.
1951	634·6	612·8	–21·8	615·3	2·5	–19·3
1952	379·4	358·0	–21·4	415·7	57·7	36·3
1953	277·8	255·9	–21·9	313·2	57·3	35·4
1951-53	1,291·8	1,226·7	–65·1	1,344·2	117·5	52·4
Average Value @ 2/20/lb. ...	2,841·96	2,698·74	–143·22	2,957·24	258·50	115·28

Compost Year	No Compost	5 tons Compost per acre	Increase over nil	10 tons per acre	Increase over 5 tons per acre	Increase over nil
1951	628·0	608·0	–20·0	626·8	18·8	–1·2
1952	387·6	379·8	–7·8	385·5	5·7	–2·1
1953	292·9	280·9	–12·0	273·1	–7·8	–19·8
1951-53	1,308·5	1,268·7	–27·8	1,285·4	24·5	–3·3
Average Value @ Shs. 2/20 per lb.	2,878·70	2,791·14	–61·16	2,827·88	53·90	–7·26

*Denotes significance at 5% and ** Denotes significance at 1% level.

Discussion.—(a) 1953. Nothing was significant. The residual response to phosphate dropped from a 15·6 per cent increase in 1952 to only a 5·7 per cent increase in 1953 for the higher level of application whilst the low level showed a decrease of 4 per cent during this season.

The results of 6 in. spacing has given the highest increased yield during its three years. Its first year was spoilt by straying cows and in the second year there was no benefit from the close spacing, in the third and fourth years the increase over the 12 in. spacing has been respectively 15·2 per cent and 20·6 per cent.

Compost has never shown itself to be of any benefit on this trial.

(b) 1951-53. The significant linear response given by phosphate has been worth Shs. 390.50 for the application of 300 lb. of superphosphate. The percentage increase is 17·75 per cent for the three years.

Experiment No. 8

The trial was competely destroyed by sheep during June and had to be abandoned. Up to the date of its destruction five of its fourteen pickings had been done. The data was analysed but was not significant and was unreliable and so the trial is omitted.

Experiment No. 14

Object.—To investigate arable rotations with pyrethrum in order to maintain soil fertility.

Design.—Randomized Blocks using plots 1/223rd acre.

Soil and Site.—The trial is situated on a shallow sandy forest soil overlying a red sandy loam on Muwengi Farm.

Treatments and Results to date

1951	1952	1953	Yield per acre 1952	1953
Oats	Pyrethrum (New) ...	Pyrethrum	295·5	643·6
Weeds	Pyrethrum (New) ...	Pyrethrum	280·1	704·6
Pyrethrum (Old)	Pyrethrum (New) ...	Pyrethrum	244·0	544·7
Peas	Oats...	Pyrethrum (New) ...	—	90·7
Pyrethrum (old) ...	Pyrethrum (old) ...	Pyrethrum (New) ...	507	102·8
Weeds	Weeds	Pyrethrum (New) ...	—	46·5
Oats	Peas	Pyrethrum (New) ...	—	105·6

The results cannot be analysed until several more seasons have elapsed.

Experiment No. 24

Object.—In 1952 this trial investigated early rainy season planting and it was continued this season to test yields in the second year.

Design.—A randomized block of four replications using plots 1/200th acre.

Soil and Site.—The trial was situated on a deep volcanic ash overlying a coarse sandy soil on Nuwi Plantations.

Treatments.—Monthly plantings starting November 15th, 1951 and ending on March 15th, 1952.

Results.—November 1952 plantings significantly yielded better than later plantings and December and January plantings significantly yielded better than later plantings: 1953, nothing significant.

1952 to 1953 November plantings significantly yielded higher than all other plantings.

Dates of Planting	Yield in lb. of Dried Flowers per acre 1952	1953	Total
November 15th 1951	970·7 ...	882·0 ...	1,852·7
December 15th 1951	685·0 ...	715·7 ...	1,400·7
January 15th 1952	564·1 ...	627·9 ...	1,192·0
February 15th 1952	369·1 ...	820·4 ...	1,179·5
March 15th 1952	252·9 ...	715·6 ...	968·5
Sign. Diff. at 5%	219·8 ...	— ...	434·75
at 1%	307·0 ...	— ...	609·6

Discussion.—Although the year's work is not significant the November plantings continued to yield higher than any other planting. An attempt was made to correlate yields with accumulated cold and length of sunshine but no correlation appeared to present itself.

Experiment No. 25

Object.—To investigate further into dry season cultivation.

Design.—Randomized block of three replications.

Soil and Site.—The trial was situated on Kilima farm on a deep volcanic ash.

Treatments.—(a) No inter-row cultivation.

(b) Fortnightly inter-row cultivation.

(c) Monthly inter-row cultivation.

Results.—The results of 1952, 1953 and the totals were not significant.

	Yield in lb. of Dried Flowers per acre		
	1952	1953	Total
No inter-row cultivation	695·6 ...	416·9 ...	1,112·5
Fortnightly inter-row cultivation	703·3 ...	448·0 ...	1,151·3
Monthly inter-row cultivation	717·0 ...	491·9 ...	1,208·9

Discussion.—Owing to some misunderstanding this trial was accidentally abandoned during August after seven of its eleven pickings had been made. The results were analysed but were not significant. It was noted during the season how the monthly inter-row cultivated plants were slowly increasing their lead over other treatments. This increase fell short of significance.

Experiment No. 32

Object.—To compare "stripping" with "reaping and threshing".

Design.—A randomized block of three replications using strips one-ninetieth acre.

Soil and Site.—A shallow sandy forest soil overlying a sandy red loam on Muwengi farm.

Treatments.—(a) "Stripping", i.e. picking down to petals horizontal at three-weekly intervals.

(b) Reaping flowers and stalks and threshing head from stalks.

Result.—During 1952 and 1953 stripping significantly outyielded reaping and threshing.

	Lb. of Dried Flowers per acre		
	1952	1953	Total
Stripping	812·9 ...	405·3 ...	1,218·3
Reaping and threshing	541·3 ...	139·9 ...	681·2
Sign. Diff. 5%	168·9 ...	— ...	—
1%	— ...	168·2 ...	502·9

Discussion.—Originally it was thought that by reaping and threshing the cost of picking could be reduced and if a by-product could be produced from the stalks the method might have competed with normal practice. However there has been no sale for stalks and the loss in yield is so great that the idea is now to be abandoned and "stripping" will continue to be the normal practice of picking.

Experiment No. 34

Object.—To see if better germination could be obtained by drilling seed in rows over broadcasting in the nursery.

Design.—A randomized block of five replications.

Site.—Nuwi plantations.

Treatments.—(a) Seed sown in furrows in nursery beds.

(b) Seed broadcast in nursery beds.

Results.—Broadcasting gave significantly more seedlings than drilling in rows.

	Number of Seedlings	Average weight per seedling
Broadcast	1,181 ...	4·04
Drilled	831 ...	4·60
Sign. Diff.	333 ...	–

Discussion.—The trial revealed no advantages in drilling over the accepted practice of broadcasting seed in the nursery. Whilst broadcasting gave very many more seedlings the higher weight of seedlings given by drilling was not significant.

Experiment No. 36

Object.—To investigate a method of obtaining a quick yield from pyrethrum; essentially designed for a new grower just starting from seed.

Design.—A 3 × 3 Latin square.

Site and Soil.—A forest soil developed from volcanic ash on Kilima Farm.

Treatments.—Sowing the following varieties in the nursery and then transplanting to the field in the same rainy season.

(1) Nuwi Seitz
(2) U/11
(3) The F2 of U/11

Results.—Insufficient time has elapsed to analyse the data.

	Lb. of dried Flowers per acre
Nuwi Seitz	32·5
U/11	29·1
F2 of U/11	31·7

Discussion.—The trial was sown in the nurseries on 10th January and transplanted to the field on 23rd April. Owing to the poor rains growth and development were slow.

Experiment No. 37

Object.—To find out what is the best time during the season to take seed and to study the effects of seed production on flower production. The trial is designed to cover two years.

Design.—A randomized block of four replications.

Soil and Site.—On forest soil developed from volcanic ash on Kilima farm.

Treatment:

A. Picking for flowers only.
B. First year picked for seed, second year picked for flowers.
C. Both years picked for seed.
D. Picked for seed in first flush and picked for flowers in second flush, both years.
E. Picked for seed in second flush and picked for flowers in first flush, both years.
F. Picked for seed in both flushes but between flushes picked for flowers.

Results.—The trial must complete the second year before data can be analysed.

	Yield of dried flowers/acre	Yield of seed per acre
A	941·7	—
B	—	246·2
C	—	261·4
D	527·4	37·1
E	445·8	235·0
F	122·4	244·5

Experiment No. 38

This trial has the same object as Experiment No. 37. It is designed the same and has the same treatments.

Soil and Site.—Sandy forest soil on Nuwi Plantations.

Results.—The trial must complete the second year before the data can be analysed.

	Yield of dried flowers/acre	Yield of seed per acre
A	628·0	—
B	—	221·8
C	—	253·2
D	353·3	38·8
E	263·6	161·2
F	105·8	195·1

Discussion.—An unexpected result so far reveals that the second flush has given a greater weight of seed than the first flush.

Experiment No. 41

Object.—To investigate the possibilities of using short rooted splits as against long rooted splits with the intention of mechanizing the operation of transplanting Also to study the effects of fertilizer placement with short rooted splits.

Design.—A 4×4 Latin square with plots one-hundredth acre.

Soil and Site.—The trial was sited on Kilima Farm on a deep volcanic ash soil.

Treatments:

	Split Size	Superphosphate under Ridge	Sulphate of Ammonia In Planting Hole.	
A	8in.	150 lb./ac.	—	
B	3½in.	150 lb./ac.	—	
C	3½in.	100 lb./ac.	50 lb./ac.	
D	3½in.	100 lb./ac.	50 lb./ac.	100 lb./acre.

Results.—There was no significant difference between size of splits or the effects of Sulphate of Ammonia but the effects of Phosphate in the planting hole and under the ridge were significant.

	Yield in lb. of dried flowers per acre
A	291·6
B	269·1
C	358·3
D	357·4

Discussion.—As it was realized that in mechanical transplanting it would be difficult to use long rooted splits it was thought necessary to experiment with

short rooted splits. The analysis of variance revealed the size of split was not significant and that a short rooted split could be expected to do as well as a long rooted split. The effects of applying Sulphate of Ammonia had no response whilst the effects of applying the Phosphate in the planting hole as well as under the ridge was significant at 5 per cent level.

Experiment No. 44

Object.—To find out if stem removal after picking would control bud rot.

Design.—A randomized block of six replications.

Soil and Site.—An ash soil not fully developed overlying a sandy clay loam on Muwengi Farm.

Treatments and Results:

	Yield in lb. of dried flowers per acre	% plant deaths
(1) Monthly stem removal ...	363·6	1·09%
(2) No stem removal	406·7	3·01%

Nothing was significant.

Discussion.—This trial was suggested by an African Headman after observing that budrot sometimes spreads down the stalk to the plant. Unfortunately there was no significant difference between treatments but as the year was such a dry one budrot was not serious.

Experiment No. 45

Object.—To investigate the best method of phosphate placement.

Design.—A randomized block of six replications using plots one-hundredth acre.

Soil and Site.—Laid down on Nuwi plantations on a shallow forest soil.

Treatments.—Phosphate placed (a) under the ridge and (b) in the planting hole.

Results.—Nothing significant.

	Yield in lb. of dried flowers per acre
Phosphate under ridge	253·6
Phosphate under in planting hole ...	224·1

Discussion.—This trial was designed to settle an age old controversy of where phosphate should be placed. Together with experiment No. 41 it appears that the best method of placement is a combination of both.

Experiment No. 46

Object.—To investigate the growth of splits taken from vigorously and non-vigorously growing plants.

Design.—Randomized blocks of six replications using plots one-hundredth acre.

Soil and Site.—The trial was laid down on Kilima farm on a deep volcanic forest soil.

Treatments.—These were splits from (a) vigorously growing plants and (b) non-vigorously growing plants.

Results.—Not significant.

	Yield in lb. of dried flowers per acre
Split from vigorous plants	151·7
Split from non-vigorous plants	210·8

Discussion.—This trial gave unsatisfactory results last year and was repeated this year and has again given unsatisfactory results. The trouble lies in selecting good and poor plants. This should be done over the year as a whole and not just at the end of the season. Suppression of certain plants was thought to be due to having less vigour but it does not seem to always follow as such plants given an equal chance are able to grow vigorously.

Experiment No. 47

Object.—To study planting techniques and see if compression of the ridge tops immediately after planting would give a better "take".

Design.—A randomized block of six replications.

Soil and Site.—On Muwengi farm on a deep fully developed volcanic ash overlying a sandy clay loam.

Treatments.—After planting the ridge top was (a) compressed or (b) left loose.

Results.—No significant differences between treatment.

	Yield in lb. of dried flowers per acre
Ridge top compressed	336·0
Ridge top loose	319·3

Discussion.—The trial was not significant but should have been significant if ridge top compression was an important factor in establishment since the year was a dry one and it would be expected that a loose ridge would have caused great loss of plants from drying out but this was not the case.

Selection and Breeding of Pyrethrum

Col. L. A. Notcutt and two members of the Uwemba Farmers' Association adopted the Hutchinson method of plant breeding and the work is now in its third of six stages. Seradix, the root hormone, was tested out on pyrethrum cuttings but no appreciable improved growth was observed.

Acknowledgments

This report is a record of yet another year of successful co-operation in experimentation between the Uwemba Farmers' Association and the Department of Agriculture.

Apart from the designing and analysis of experiments the main work has been carried out by Col. L. A. Notcutt and the Uwemba Farmers with the help of the two departmental recorders.

R. Frank,
Agricultural Officer, (Experiments)

SUMMARY OF THE ANNUAL REPORT OF THE AGRICULTURAL OFFICER (COAST AGRICULTURAL STATION), CHAMBESI, FOR THE YEAR 1953

During 1953, the station's third year, the main effort was again concentrated on bringing the station into a well tended condition. The coconut plantations with the exception of one area to the north-east have all been cleared of bush and grass growth brought under control. Some 3,500 dead palms were buried during the year and apart from current casualties and the one area still to be dealt with sanitation of the plantations is good.

Sixty-five acres of coconuts were planted during 1953 and land was prepared for planting a further 120 acres next year.

Two coconut experiments were planted during the long rains. One is designed to ascertain the effect and economics of annual intercropping between the young palms before they come into bearing. The other seeks to determine the effect of the size of the planting hole combined with various artificial and organic fertilizer treatments at planting time and during the life of the palms. Establishment so far is good though some supply was and will be necessary on account of damage caused by the coconut beetle. These experiments cover some fifty acres and are included in the sixty-five acres mentioned above. Results are not yet available.

Investigations into the control of coconut pests particularly the Rhinoceros beetle have been started in collaboration with the entomologist and investigations on the control of Theraptus are projected.

Fifteen acres of cashew nuts, the seed of which had been obtained from Zanzibar and Portuguese East Africa, were planted and the young trees made remarkable growth being over five feet high at the end of eight months from sowing.

Some annual crops were grown during the main rains but yields were disappointing. Further buildings were erected during the year and these included African quarters, a copra kiln, copra store and compound and a petrol store. In addition a new implement and tractor shed cum workshop was built, much of the material being salvaged from the old sisal factory on the estate. New offices were constructed on the upper storey of the Arcon building.

The production of copra started in October and since then all but a few nuts picked were converted into copra. Coconuts to the value of some 28,000/- and copra valued at some 7,000/- were sold, giving an increase in revenue despite reduced yields due to drought conditions of some 6,500/-.

Individual yield recordings of some 12,000 trees continued during the year.

Observation trials on fifty hibiscus varieties indicated that five of these only showed promise and it is intended that the area to be planted to these types is to be increased in 1954 subject to any adverse report upon the samples that have been sent to the United Kingdom for testing.

The sugar cane collection now totals one hundred varieties and while no experimental work is being carried out planting material will be maintained and be available when the canes have been given a clean bill of health by the plant pathologist.

Planting material of thirteen varieties of mosaic resistant cassava was established. The cassava has grown well and has shown a considerable degree of resistance. The majority of these varieties are palatable and local Africans are interested in obtaining planting material. Other crops planted included: Japanese loofahs, Hermaphrodite pawpaw, Lucerne and subterranean clover, maize and cow peas.

J. S. GUNN.

SUMMARY OF THE ANNUAL REPORT OF THE OFFICER-IN-CHARGE LUPIRO FOOD FARM FOR THE YEAR 1953

Mention has been made in Part 1 of this report of the results of the paddy pilot schemes at Lupiro and to the fact that other trials were also laid down.

Herbicide trials both pre- and post-emergence were carried out. In the pre-emergence trials the following were used:—Verdone, Amine salts and Triethylamine salt 2, 4, 5 - T. It was found that all three herbicides gave good control over weeds and that while the best control was obtained with the Triethylamine salt the paddy plant mortality was the highest with this treatment. It would appear that the paddy plant is extremely sensitive to pre-emergence spraying with these herbicides, a fact which is unfortunate as this is the most convenient time for the application on a field scale the land being in a dry enough condition to allow tractors to work. With fuller trials using varying rates of acid equivalent it may be found possible to obtain a fair weed control without a high mortality of paddy.

In the post-emergence trials, Ditox, Verdone, 2-Ethyl Butyl Ester, Butyl Ester, Amine salts and Triethylamine were used. Results showed that all herbicides successfully controlled weed growth. Little or no damage was done to the paddy plants. It is difficult at the moment to see how herbicides can be applied as a post-emergence measure on a field scale as normally the ground is too wet to allow tractors to work. Track tractors might be able to travel but some crop damage would be inevitable. It is intended that more precise experiments shall be carried out during 1954.

Seed rate trials with six randomized blocks were laid out with sowings of 65, 88 and 126 lb. per acre. The variety planted was Kahogo and the soil was of a light sandy type. It was noticed early on in the experiment that the lower seed rates produced a greater number of tillers than the higher rates and that the tiller heads ripened unevenly and were generally of a lower standard than the singleton plants. Despite the greater number of heads with the lower seeding rates yields were not materially increased and it is considered that the drought had a good deal of influence on the results of this experiment.

Fertilizers.—An observation trial was carried out in which plots were drilled at seeding with superphosphate. Two rates of application were used, 1 cwt. and 1½ cwt. per acre. Fertilized plots headed a week earlier than the control (no fertilizers) and were more uniform in appearance. Treated plots also withstood the dry conditions better and recovered more rapidly after rain fell than the untreated.

Yields were as follows:—

At 1½ cwt. of superphosphate p.a. 2,614 lb. p.a. (control 996 lb. p.a.)

At 1 cwt. of superphosphate p.a. 2,564 lb. p.a. (control 1,195 lb. p.a.)

It is intended to carry out a more scientific experiment next year.

A trial on two quarter-acre plots in order to compare the application of one cwt. of sulphate of ammonia as against no fertilizers was also carried out. Plants in the treated plot headed before the untreated and were greener and more

robust. Although they suffered from the drought they recovered well after rainfall. It is estimated that 30 per cent of the crop in the treated plot and 10 per cent from the untreated were lost due to lodging.

Comparative yields of paddy were:—

Fertilized plot 3,100 lb. p.a. and from the unfertilized 2,490 lb. p.a.

A fuller randomized trial using sulphate of ammonia at varying rates of application gave the following results:—

½ cwt. of sulphate of ammonia per acre—1,444 lb. p.a.
1 cwt. of sulphate of ammonia per acre—1,488 lb. p.a.
1½ cwt. of sulphate of ammonia per acre—1,568 lb. p.a.
Control—no fertilizer —1,179 lb. p.a.

Throughout the dry period experienced the fertilized plots looked stronger but lodged more severely than the plots with no fertilizer.

H. E. Hubbard,
Field Officer

IGUMBIRO TOBACCO FARM, IRINGA, 1953

Inadequate and badly distributed rains followed by drought made experimental work very difficult.

Tobacco

Owing to the steady increase of nematode incidence on Igumbiro tobacco farm over the past few years a new tobacco station has been found to take over the work of tobacco experimentation. Due to this the year's experimental work was considerably reduced. During the season however work was continued in pursuit of a suitable non-amarello variety of tobacco to take the place of Ehlers. The work consisted of growing and selecting from the two best varieties from the 1952 variety trial, namely Yellow Special and Delcrest.

Cut worm and eel worm trials were laid down to investigate further into the control measures of both pests. However with the non-appearance of cut worm on the former trial no results were possible. The control of eelworm afforded by the proprietary chemicals in the latter trial gave no result either from the total yield produced or in the incidence of nematode attack.

Seed production of Ehlers was continued successfully during the year and on four and a half acres planted 12,000 plants were bagged and these produced 4,000 ounces of cleaned seed which were delivered to the Southern Highlands Non-Native Tobacco Growers Union.

Trials and multiplications were carried out on other crops and included maize, sorghum, cassava, sweet potatoes, soya beans and green manure crops.

R. Frank,
Agricultural Officer (*Experiments*)

MOROGORO FARM REPORT, 1953

The standard of the dairy herd was materially improved by the introduction of twelve cows from Mpwapwa together with a Sindhi-Sahiwal bull, progeny of a 500-gallon dam. Later in the year five grade heifers were purchased from Kingolwira Prison farm. Corresponding numbers of low yielding cows were culled from the herd. The net result was a satisfactory increase in milk supplies and revenue without an increase in the size of the herd. The sale of milk in 1953 amounted to 6,215 gallons compared with 4,515 gallons in 1952.

Machinery purchased for the farm included a hay rake, a two-row maize planter, a maize sheller and a small hammer mill.

The latter paid for itself in less than six months, for when fitted with a special sieve cotton seed and maize were milled together for feeding to the cattle thereby raising production from eighteen to twenty gallons of milk per day.

The citrus orchard produced a good crop, the bulk of which was sold in Dar es Salaam. The farm nursery was increased in size and over 17,000 citrus and tropical fruit trees and ornamentals were sold during the year.

The maize harvest was poor and only eight tons were harvested from twenty acres. Half a ton of selected Katumbili maize seed was sold to farmers and selection was carried out on this variety and on Eksteen for future use on the farm. Surplus maize was fed as part of the ration to the dairy herd. Enyanza sorghum yielded two tons from three acres. Selection for dwarf character coupled with high yield was continued with sorghums and a small quantity of seed of ten varieties of dwarf sorghums was received from Mr. Karper of Lubbock, Texas. The most promising varieties were Tada (S.A.6714) and Double Dwarf Early Shallu (S.A.66-57-25). The latter has a white pearly grain and yielded ten and a half pounds from a single test-tube of seed. The former is a brown seeded dwarf variety which is reported to be bird resistant as the grain is bitter in the milk dough stage though palatable when ripe. Nine and a half pounds were harvested from a similar quantity of seed. These two varieties were bulked up under irrigation during the dry season and will be planted in bulk during the coming year. Revenue from the farm for the sale of milk, planting material, onion seed and fruit amounted to £1,989.

TRIBAL FARMS, CENTRAL PROVINCE, 1953

Dodoma Tribal Farm

Despite improved methods of cultivation, manuring and improved seed, all crops were a complete failure owing to lack of rain. No analysis of experiments was possible. A small dam constructed below number one dam to catch seepage and water from the filter house kept the farm and a number of local Wagogo supplied with water throughout the year.

Singida Tribal Farm

Erratic rains resulted in very low yields except in the case of Dobbs sorghum which produced nine bags per acre. Throughout the season the cattle remained in excellent condition and were far better than local stock in the neighbourhood.

Kondoa Tribal Farm

Reasonable harvests were obtained despite poor rains and a considerable quantity of Enyanza sorghum was harvested and sold for seed. Little interest was taken in the farm by local Africans and few requests were received for ox ploughing of fields in the vicinity. Every encouragement is being given however to Africans to have their oxen trained for ploughing.

SUMMARY OF THE ANNUAL REPORT OF MAHIWA EXPERIMENTAL STATION, SOUTHERN PROVINCE, FOR THE YEAR 1953

Rice continued to be the main concern of this station and the 1953 experimental programme included the following.

Rotation Experiment with the following four treatments (a) Kudzu, Kudzu, Rice, Rice, Rice; (b) continuous rice as control; (c) cassia loppings puddled in prior to planting to rice each year and (d) rice followed by a catch crop of sweet potatoes each year. Treatment (c) gave significantly higher yields of rice than the control at the 5 per cent level. The experiment is being continued.

Manurial Experiment with three treatments:—

(a) complete artificials at the rate of two cwt. per acre.

(b) 8·6 tons of farmyard manure per acre.

(c) completely unmanured plots as control.

Farmyard manure gave a significantly better yield at the 1 per cent level. The 1952/53 planting was the last to be treated and in future residual values of the treatments are to be tested.

Variety Trial.—Four strains of Kahogo were compared. No significant differences were shown. The trial is to be continued.

Contour Plot Experiments.—The object is to compare hill and swamp rice under normal conditions. To date the swamp varieties have proved the best but no statistical analysis was possible.

Weedicide Experiments.—with three treatments:

(a) Single strength Fernoxone

(b) Double strength Fernoxone, and

(c) Control.

There was no significant difference in yield though the double strength Fernoxone appeared to damage the rice as well as the weeds. The treatment was applied rather late.

Line selections with thirteen selected strains were tried and of these only Afaa Kilombero and Afaa Rufiji M 194 were significantly worse than the remainder. Line selections are to be discontinued and further selections will be made in the field.

The Allen scythe proved a possible answer to the problem of harvesting the larger acreages that it is desired that the African cultivator should grow and trials with the machine will be continued. A treadle thrasher has been ordered.

Four Malayan varieties of rice were planted in association with *Tilapia nilotica*. The rice was a success but the fish results were disappointing. Trials are to be continued in four plots using the same rice varieties with *T. nilotica* and *T. melanopleura*.

Cassava, sorghum, hibiscus, oil palms and cashew nuts were the subject of trials and observations. Cassava was planted to test the susceptibility of five Amani and one local strain to mosaic and brown leaf streak disease. An experiment to determine the optimum time of harvesting cassava and one on spacing cum ridge cultivation versus flat cultivation were planted.

A small dairy herd is maintained at this farm and a project for feeding calves from it and from another herd in Lindi up to beef weights has commenced.

J. B. Clegg,
Agricultural Officer in Charge

SUMMARY OF THE ANNUAL REPORT OF MWANHALA AGRICULTURAL STATION, WESTERN PROVINCE, FOR THE YEAR 1953

The year's work on this farm was not very successful for crop production due to the delayed arrival of the rains and their subsequent irregularity.

The farm has been re-organized and is now being run on a mixed husbandry basis one of the main objects being to test the economics of grazing immature stock to beef weight after approximately two years on the farm.

The 320 acres of farm grazing is divided into eleven paddocks for rotational grazing. Apart from a mild attack of foot and mouth disease the cattle remained in good condition and made satisfactory progress.

Fourteen acres of land were under small plot agronomic trials, unfortunately producing little result due to the same climatic causes that affected the main crops. These experiments were as follows:—

(*a*) *Fallow Manurial Trial.*

1. Sorghums and groundnuts: No manure. Continuous cultivation control.
2. Sorghums and groundnuts: Three tons shed manure/acre every third year. Continuous cultivation (First applied this year).
3. Sorghums and groundnuts: 110 lb. single superphosphate/acre every third year. Continuous cultivation (only 45 lb./acre applied this year).

4. Tumbledown fallow	3 years grazed	To be followed by 3 years of sorghum and groundnuts to complete the rotation.
5. Tumbledown fallow	3 years not grazed	
6. Pigeon pea	3 years not grazed	
7. Cassava	3 years not grazed	
8. Planted grass fallow	3 years grazed	

Crops on the cropping section, Wiru sorghum intercropped with Asilia groundnuts.

(b) Single stand versus two crop mixtures

(c) Time of planting and method of cultivation (tie ridged, ridged and flat)

(d) Fertilizer trial combination of N.P.K., lime and manure

(e) Maize stalk borer control (DDT dusting).

The main results indicated that:

(a) With maize tie ridged and ridged treatments at the first time of planting were significantly superior to flat cultivation and to all treatments at the second and third time of planting.

(b) On the fertilizer trials with bullrush millet superphosphate gave significant increases in crop whilst kraal manure did likewise but to a lesser extent. A combination of kraal manure and superphosphate gave the highest yields of all. Lime caused a significant decrease in yield and both sulphate of ammonia and muriate of potash produced no significant effect.

C. C. SHAPLAND,
Agricultural Officer in Charge

KUNGULUI FARM, TANGA PROVINCE, 1953

The fifteen varieties of European potatoes planted in 1952 were harvested during the year. None of these varieties were infected by *Phytopthora infestans*. Superior varieties for storing are 1792 a (3), 1790 a (2) and 1512 a (8); while variety 1564 a (14) which is a higher yielder rots in storage.

Twelve new varieties were received by air from the Scottish Plant Breeding Station, Corstorphine, for trial. Of these two varieties only succumbed to *Phytopthora infestans* although all the remainder had *Alternaria blight*. Variety 1521 c (3) continues to be the most promising and whilst it is not a very heavy yielder it has not as yet been attacked by *Phytopthora* blight and one hundred and fifty boxes of this variety have been distributed for multiplication to African growers.

In addition to the work on potatoes observations were carried out on strawberry varieties. Cambridge early pine has been found to be the best for Lushoto conditions and its multiplication is being pushed ahead.

Plots of black and white peppermints and essential oil lavender were maintained as a source of planting material.

EAST AFRICAN AGRICULTURAL AND FORESTRY RESEARCH ORGANIZATION FERTILIZER TRIALS, 1953

Eight fertilizer trials originally laid down by officers of East African Agriculture and Forestry Research Organization were continued in 1953 to measure residual responses. Seven of these were testing second year residual effects in the Shinyanga District of the Lake Province and included comparisons of several forms of phosphate with dung, nitrogen and potash. Using sorghum as the indicator crop significant increments in yield were obtained only from those plots originally receiving five tons dung per acre and then only in four trials. Some beneficial effect remained in one trial from phosphate plots not receiving dung but the other fertilizers showed no residual effect.

In the eighth trial on sandy soils at Mwanhala plots which had received silicophosphate in the first and second year of the trial gave a highly significant increase with Bambara groundnuts in the third year. No increases in yield were obtained from nitrogen and potash applied in the first and third year.

In a new factorial experiment at Mwanhala testing nitrogen, phosphate, potash, lime and dung, only phosphate and dung gave significant increments in yield with bulrush millet. A further increase in yield was obtained where they were applied together. The application of lime significantly depressed the yield.

Two new exploratory trials testing nitrogen, phosphate and potash at three levels, were laid down on a reddish-brown, slightly acid loam at Handeni. Using maize as the indicator crop phosphate gave a highly significant linear response of 234 lb. of grain per acre on a mean yield of 1,340 lb. per acre. No other fertilizers either separately or in combination gave significant yield increase.

EXPERIMENTS IN THE NORTHERN PROVINCE, 1953

A number of experiments were laid down by the agricultural officers in Moshi, Arusha and Mbulu Districts. These included fertilizer, irrigation, spacing and variety trials with wheat, maize, cotton, sorghum and sugar.

Fertilizer Trials

Four fertilizer trials with wheat were made on red loam soils at Ngare Nairobi, Moshi; Loljoro, Arusha and Mbulu Districts. Two of these included nitrogen, phosphate and potash applied separately and in combination. Two others compared different rates of application of double superphosphates. No significant increases in yield were recorded from any of the trials although in the Mbulu trial plots receiving potash, phosphate in combination with nitrogen or potash, and all three nutrients together gave some interesting increases over control. This trial was on a sandy soil of granitic origin whereas the others were on volcanic soils generally well supplied with phosphates.

The results from a fertilizer trial with maize on volcanic loam at Arusha are of considerable interest, and are shown in the following table:—

TABLE I

Results of a Fertilizer Trial on Maize in the Arusha District

	Bags (200 lb.) per acre	
O	18	
NPK	18·2	
NK	19·8	
N	19·9	Sig. difference
P	20·5	(P·05)
NP	20·7	2·1 bag p.a.
K	21·2	
PK	21·4	

Nitrogen as ammonium sulphate and phosphate as double superphosphate were applied at 160 lb. p.a. and muriate of potash at 80 lb. p.a. both separately and in combination. The most interesting and unexpected result was the significant response to potash which gave a 17 per cent increase over the control yield. Phosphate alone also gave a significant increase which is of interest on this volcanic soil. The poor results from NPK, NK & N are difficult to explain but may have been due to damage to the roots by a high concentration of soluble salts shortly after application. Further trials will be made.

In a year of low rainfall maize on a red loam soil in Moshi District gave no significant responses to a number of different rates of application of double superphosphate.

Plant cane was harvested from an experiment in Moshi District designed to find the optimum level of application of ammonium sulphate to irrigated sugar cane. As shown in Table II yields of sugar were considerably increased by raising the dressing of fertilizer from 2 cwt. to 2½ cwt. per acre but no further response was obtained by increasing the dressing to 3 cwt. per acre. Cane from

the plots receiving 3 cwt. per acre showed a slight immaturity however and better results might have been obtained had the cutting been delayed. The experiment is to be repeated with ratoon cane.

TABLE II

YIELDS OF SUGAR IN TONS PER ACRE FOR A FERTILIZER TRIAL ON IRRIGATED SUGAR CANE

Treatment	Yield	Value of sugar @ £40 per ton	Net value of sugar
		Shs.	Shs.
0	9·135	7,308/-	7,308/-
1 cwt. sulphate of ammonia p.a.	9·520	7,616/-	7,581/-
1½ cwt. sulphate of ammonia p.a.	10·037	8,029/-	7,977/-
2 cwt. sulphate of ammonia p.a.	10·210	8,168/-	8,098/-
2½ cwt. sulphate of ammonia p.a.	11·963	9,570/-	9,483/-
3 cwt. sulphate of ammonia p.a.	11·635	9,308/-	9,203/-

Sig. diff. (P = ·01) 0·635 tons.

IRRIGATION TRIALS

Two irrigation trials one with cotton and one with maize were made on an alkaline grey alluvial silt in Moshi District. In these trials the rainfall was made up by irrigation to 1 in., 1½ in., 1¾ in. and 2 in. or 2¼ in. per fortnight.

With cotton all treatments receiving additional water gave very large and significant increments in yield but there was no difference between the four rates of additional water. The large increase in crop from the lowest rate of added water is of considerable interest. From these results it can be calculated that allowing for loss of water in the furrows one cusec could irrigate 150 acres of cotton under these conditions.

Results with maize followed a different pattern, the critical amount of water appearing to be 1¾ in. every fortnight or 14 in. spread evenly over the three and a half months' growing season. Allowing for the natural rainfall and loss of water in the furrow it can be calculated on the one year's result that one cusec could irrigate 100 acres of maize in this locality.

The results are given in Table III.

TABLE III

RESULT OF IRRIGATION TRIALS WITH COTTON AND MAIZE

Crop	Treatment	Amount of water actually received	Yield seed cotton lb. p.a.	
Cotton ...	0in. ...	4·21in. ...	1,168	Rainfall 4·21 in. from 26.3.53. to 18.8.53.
	1in. ...	11·31in. ...	2,400	
	1½in. ...	16·50in. ...	2,192	
	1¾in. ...	19·25in. ...	2,672	Sig. diff.
	2¼in. ...	24·75in. ...	2,760	(P = ·05) 624 lb.

Crop	Treatment	Amount of water actually received	Bags of 200 lb. p.a.	
Maize ...	0in. ...	3·91in. ...	0·44	
	1in. ...	8·31in. ...	2·12	Rainfall 3·91in. from 24.3.53 to 9.6.53.
	1½in. ...	12·00in. ...	4·88	
	1¾in. ...	14·00in. ...	7·04	Sig. diff.
	2in. ...	18·00in. ...	7·80	(P = ·05) 1·40 bags.

Spacing Trials

A trial with dwarf sorghum on red volcanic loam, comparing three row widths 6 in., 12 in., and 24 in. each at three spacings 4 in., 8 in. and 12 in. within the row suffered badly from drought and gave no significant differences in yields. In a similar experiment in 1952 the closest row-spacing gave significantly greater yields than the wider spacing and in 1953 the mean yield from the closest spacing showed the same tendency.

With a view to investigating much wider spacing between the rows of maize to assist cheaper inter-row cultivation a trial was made on red loam at Moshi comparing single and double rows at 6 ft. apart with varying plant densities with single rows at 3 ft. apart with two plant densities. Half of each plot was ridged two months after sowing.

The results are shown in Table IV.

TABLE IV

Maize Spacing Trial—Moshi District

Treatment, row & plant spacing in feet	Plants per acre	Yield in bags of 200 lb. p.a.
3 x 1½	9,680	14·21
3 x 3	4,840	14·07
6 x 1½ x 1½	7,440	13·82
6 x 1½ x 1	11,280	12·26
6 x 1 x 1	12,880	12·15
6 x 1 x 1½	8,500	11·99
6 x 1½	4,840	11·91
6 x 1	7,260	11·29

Sig. diff. (P = ·01) = 1·09 bags p.a.

Note: In the double row treatment the second figure is the distance between the double rows.

The first three treatments yielded equally well and were all significantly superior to the other treatments. These results were obtained in a year of low rainfall only 17·96 in. falling during the growing period of the maize and the trial is to be repeated.

Ridging gave a significant increase of 0·80 bags per acre.

Variety Trials

Three trials of wheat varieties were laid down at 4,800 ft., 5,600 ft., and 6,100 ft. on the north-western slopes of Kilimanjaro. That at 5,600 ft. was ruined by bird damage. At the lowest altitude, WI, Kenya Governor and 26IR gave the best yields. 294B which has done well in other years gave significantly lower yields than the best three in 1953. In the high altitude trial, 294H, with a yield of 14·48 bags per acre, outyielded Kenya Settler, 337, 341, 360H, Regent and 321; 294H lodged badly however. 294M did well and gave a similar yield to 294H; Kenya Settler and 337 also yielded well.

In Mbulu one trial was laid down with high altitude wheats. 360H, yielding at 11·65 bags per acre, significantly outyielded 294M, 44/34, Regent and Sabanero but was not significantly better than 350H.

Two cotton variety trials under irrigation were made on alkaline grey alluvial silt in Moshi District comparing an Ilonga bulk the new Ilonga 47/10, newly introduced BP52, seed from an old introduction of BP52 and S47. Although the results were not significant the new BP52 gave considerably higher yields than the other varieties in both trials. Ilonga 47/10 gave the lowest yields.

Land Reclamation Trial on Saline Soils, 1953

A study of methods of reclamation of certain saline soils which might provide expansion areas for Africans from the over-populated Usambara mountains has been initiated in the Luengera Valley. Water for irrigation is available and the methods under trial are leaching combined with deep drainage with and without the use of gypsum. Sisal waste has also been included in the trials in an attempt to improve soil structure.

Acre fields divided by ditches three feet deep, subdivided into quarter-acre plots by bunds have been laid out. Three quarter-acre plots were used for the trial. Water was applied by shallow furrows and drained off through the deep ditches. Prior to planting, the least saline plot, No. 1 in the following table, received five floodings, and the other two fifteen floodings each to a depth of one foot. Sisal waste at fifteen tons per acre was applied to a half of each of two plots and gypsum at five tons per acre was applied to a half of the third plot. Rice was planted on all plots on 29th November, and received forty irrigations of approximately two inches each twice a week during the growing period.

The results are set out in the following table.

From these results it will be seen that leaching alone has had a very considerable effect towards reclaiming these soils. The exchangeable Na was much reduced in all plots to the extent that plots 1 and 2 with percentages below the generally regarded safe limit of fifteen per cent at depths below a foot are now almost non-saline. Plot 3 requires further treatment and the experiments are to be continued. It will be important to observe the behaviour of the second and later crops.

TABLE

RESULTS OF LEACHING TRIALS ON SALINE SOIL—LUENGERA VALLEY

Sample	Treatment	pH		Conductivity		Exchangeable Na %		Gypsum requirements. (Tons/acre)		Gypsum reserves (Tons/acre)		Gross yield of paddy lb./acre
		Nov. '52	May '53	Nov. '52	May '53	Nov. '52	May '53	Nov. '52	May '53	Nov. '52	May '53	
Plot 1:												
0—1 ft. ...		6·3	7·1	2,600	80	54	23	2·6	0·4	1·1	0·2	
1—2 ft. ...	Untreated	6·2	7·1	3,000+	80	42	11	1·9	–	2·5	0·1	2,292
2—3 ft. ...		6·1	7·0	3,000+	70	100	8	5·4	–	7·3	0·2	
0—1 ft. ...			7·0		110		16		0·2		0·7	
1—2 ft. ...	Sisal waste @ 15 tons p.a.		7·0		65		11		–		0·1	2,312
2—3 ft. ...			7·1		70		5		–		0·1	
Plot 2:												
0—1 ft. ...		6·9	6·8	3,000+	120	85	14	4·6	–	1·1	0·1	
1—2 ft. ...	Untreated	6·5	7·0	2,000	165	47	14	2·8	–	2·5	0·1	1,646
2—3 ft. ...		6·8	6·9	1,500	190	86	9	4·9	–	7·3	3·6	
0—1 ft. ...			6·6		230		11		–		0·3	
1—2 ft. ...	Gypsum @ 5 tons p.a.		6·6		500		12		–		1·0	1,750
2—3 ft. ...			6·7		260		11		–		1·3	
Plot 3:												
0—1 ft. ...		5·6	6·6	3,000+	290	92	21	6·9	0·5	n.d.	1·4	
1—2 ft. ...	Untreated	6·7	7·2	3,000+	850	33	18	1·2	0·8	19·6	1·6	1,583
2—3 ft. ...		7·5	6·3	3,000+	2,250	95	29	5·3	1·6	14·4	1·6	
0—1 ft. ...			6·4		1,350		34		2·7		0·4	
1—2 ft. ...	Sisal waste @ 15 tons p.a.		6·7		1,550		33		1·8		0·1	2,042
2—3 ft. ...			7·0		1,150		16		0·1		0·2	

NOTES ON TRIALS IN TANGA PROVINCE, 1953

Three fertilizer trials with pineapples are in progress at Muheza. These include dressings of ammonium sulphate with and without a hormone preparation and dressings of nitrogen, potash and phosphate separately and as a combination of all plant nutrients. In the last experiment plots have been split to test spraying with Bordeaux mixture in an endeavour to check black rot. No results are yet available.

Two fertilizer trials including nitrogen, phosphate, potash and dung were laid down with maize on red loam and sandy coastal soils. Due to poor establishment no significant responses to fertilizers were received. On coastal sands there was a considerable response to dung measured by plant weight.